A CAHNERS PUBLICATION INTERNATIONAL EDITION MARCH 6, 1986

EDN

13 JUN RECD

Quad-transistor IC improves linear-circuit performance

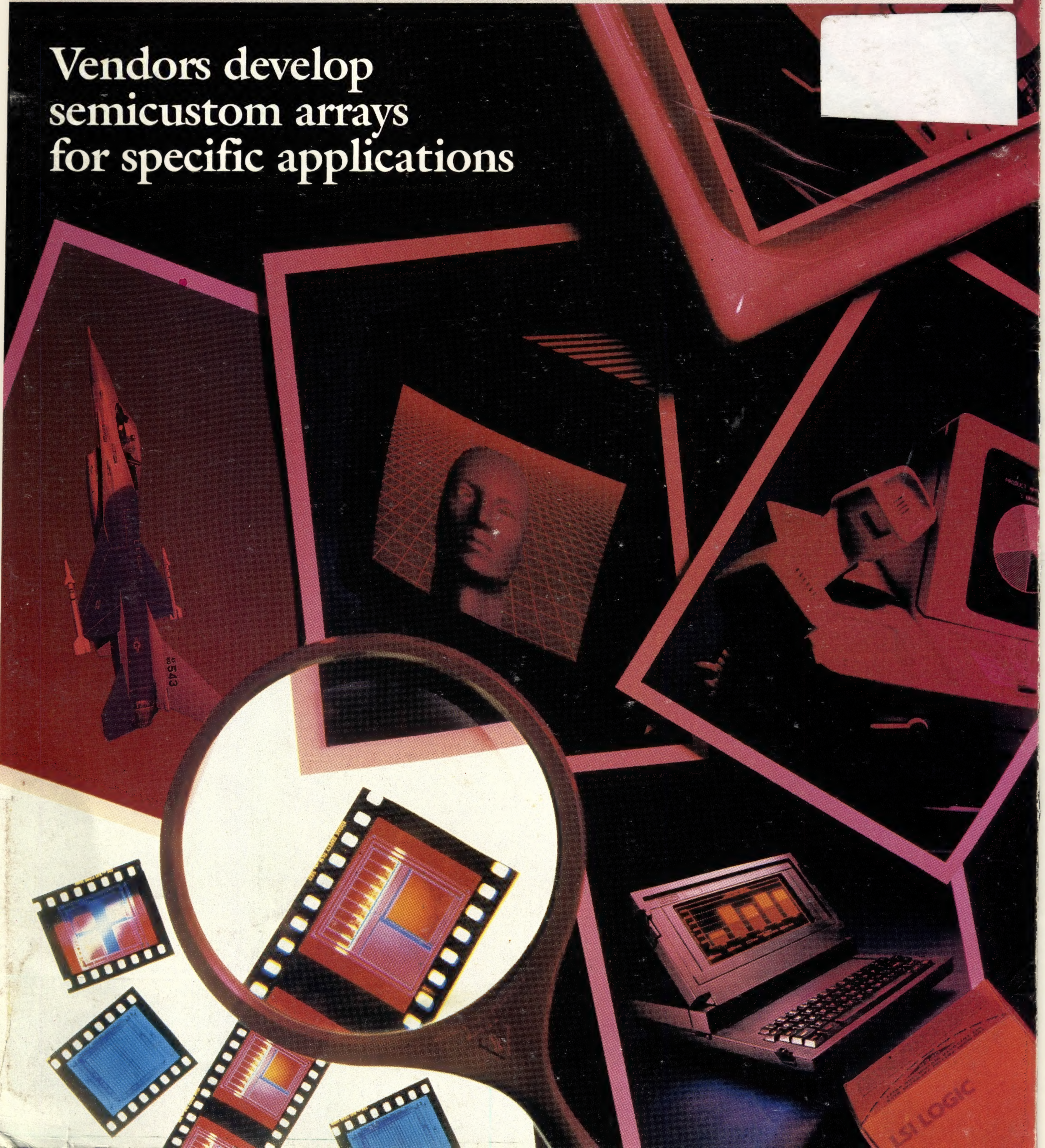
VME Bus and Multibus II industrial I/O boards

GaAs linear ICs

Filter connectors

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS

Vendors develop semicustom arrays for specific applications



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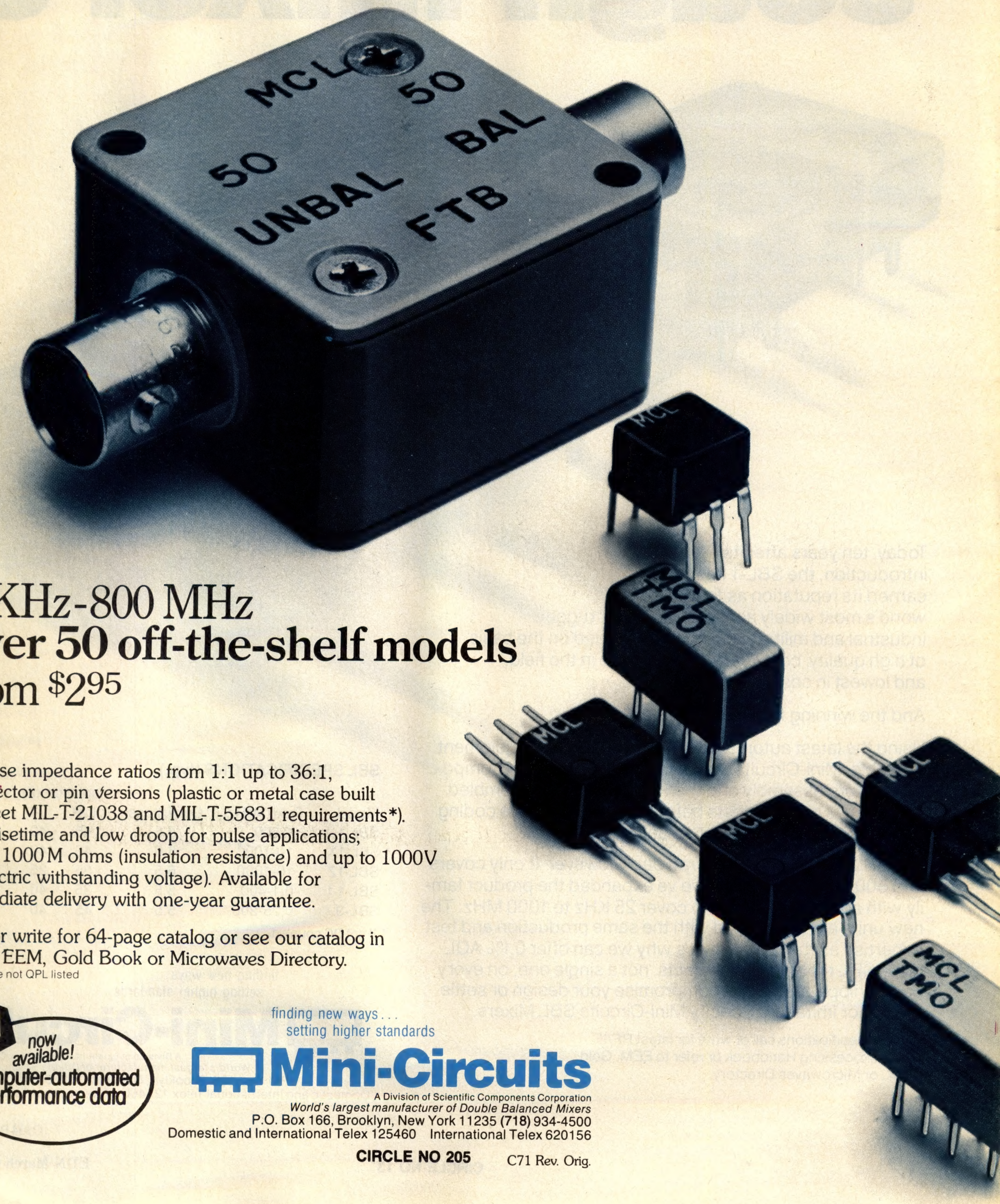

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CIRCLE NO 205

C71 Rev. Orig.

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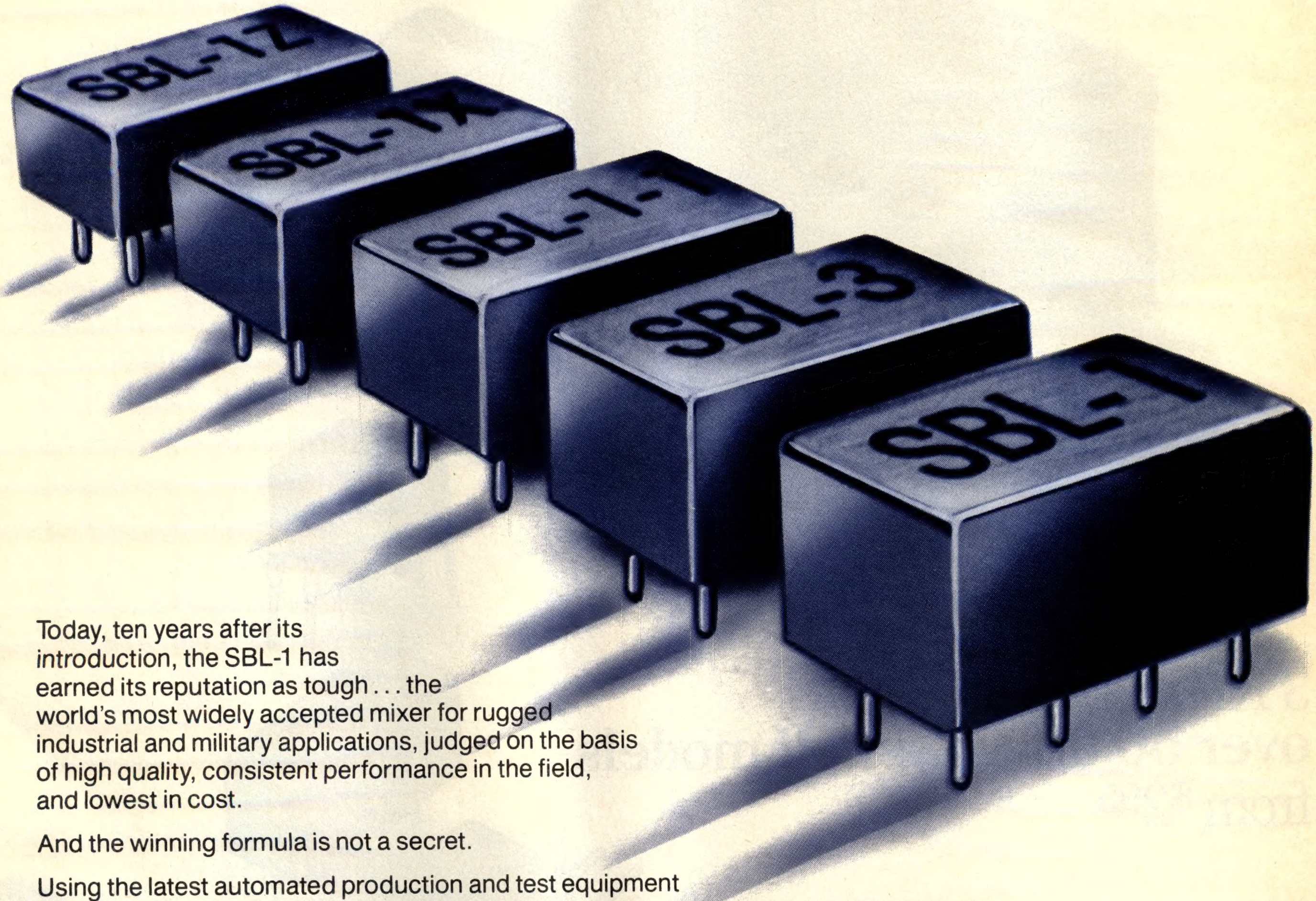

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C104 REV. ORIG.

CIRCLE NO 13

Volume 32, Number 5

EDN

March 6, 1986

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS

On the cover: *Picture your designs implemented in semicustom arrays: The arrays listed in this year's directory can replace not only discrete random logic but also MSI and LSI chips in many applications. See pg 96. (Photo by Imagination, courtesy LSI Logic)*

DESIGN FEATURES

Semicustom-array directory 96

This year's semicustom arrays offer much higher density, more functions, improved performance, and greater reliability than did earlier arrays. Semicustom arrays are now suitable for portable systems, computers, memory subsystems, and automotive circuits.

EDN Semicustom-array tables 112

Gate-array vendors and services 127

VME Bus and Multibus II industrial I/O boards 191

In this directory, you'll currently find a wide variety of VME Bus analog, digital, and specialized I/O boards for industrial-I/O systems that can fit in a single Eurocard rack. In terms of I/O-board support, Multibus II is just beginning to emerge as a viable alternative.

Diverse circuits exploit matching in quad-transistor IC 223

You can exploit the close parameter matching of the transistors in a quad-transistor array to realize a variety of circuit applications. The low offset-voltage differentials and tight beta matching make the IC suitable for linear circuits, and the low bulk resistance suits the array to logarithmic applications.

Connect terminals to your CPU over PBX telephone lines 239

Voice-digitizing ICs allow telephones and data terminals to share 2-wire access channels within a complex. You can use the ICs to build a voice/data modem that provides simultaneous voice and data transmissions while reducing your in-house cabling costs.

Continued on page 7

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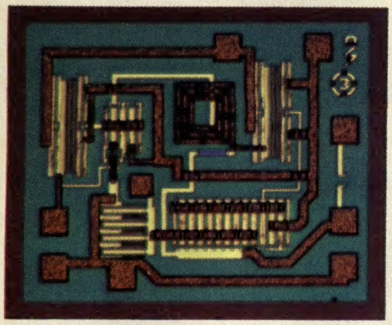

GaAs ICs have thus far found use mainly in military equipment, but as prices come down, GaAs circuits promise to find increasing use in telecommunications, instrumentation, data-processing, and even consumer applications (pg 57).

***Filter connectors**, which have long been used in military applications, are now inexpensive enough to be suitable for commercial and industrial systems (pg 69).*

TECHNOLOGY UPDATE

Gallium arsenide monolithic linear ICs gain in affordability and availability — 57

At the point of overcoming their traditional image as expensive laboratory curiosities, GaAs-processed linear ICs are becoming more available and more affordable. Once available only in custom form (usually to military contractors at very high prices), the ICs now also take the form of catalog items from several newly formed and established manufacturers.

Filter connectors offer a cost-effective solution to EMI/RFI problems — 69

FCC regulations require commercial- and industrial-equipment designers to incorproate EMI/RFI shielding in their electronic systems. Filter connectors can protect a system from EMI/RFI characteristics without incurring great expense or signficantly decreasing your system's performance.

PRODUCT UPDATE

High-speed logic-to-logic optocouplers 83
Hardware-development tools 84

DESIGN IDEAS

Standby clock takes over in 1 μsec 255
Variable reference extends converter's resolution 256
Test probe measures 4 to 220V 256
Simple timer requires no A/D converter 258
Circuit and ground plane share one surface 260

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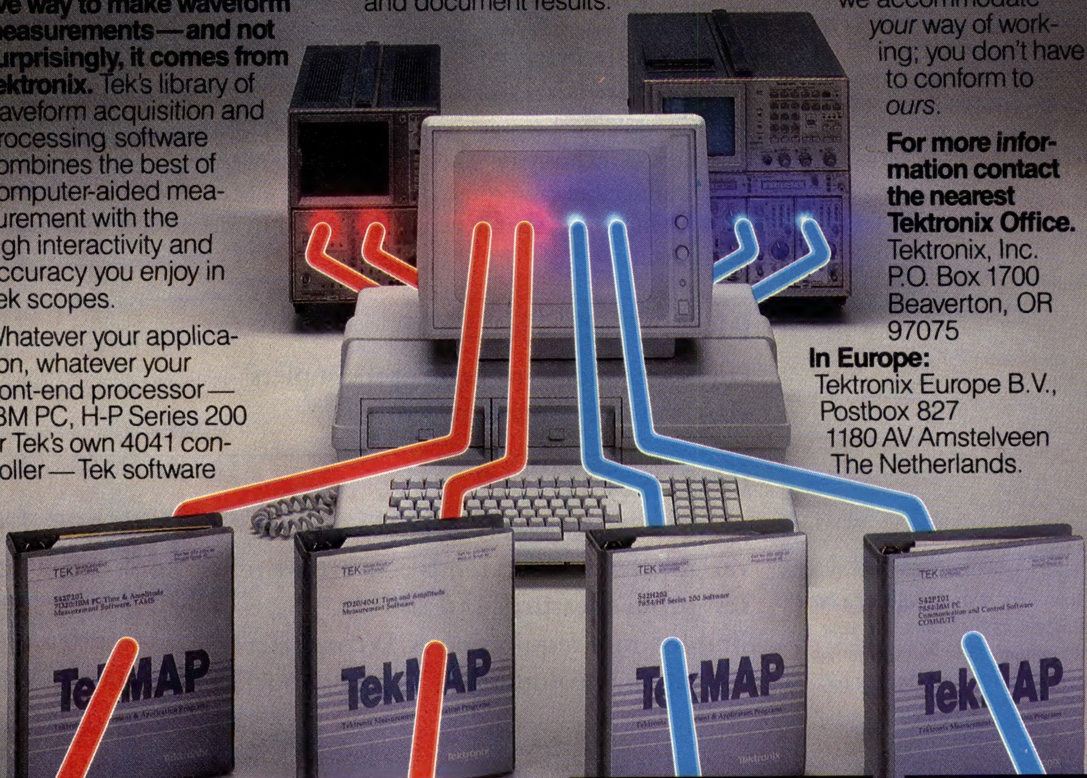
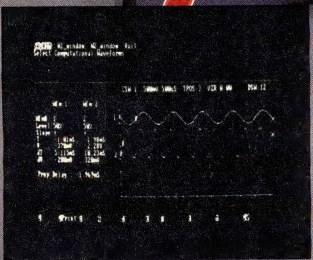
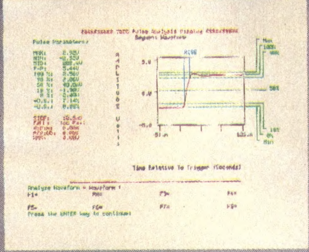
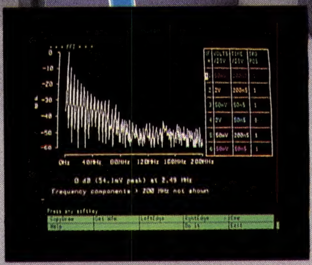




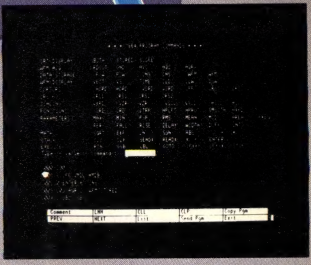
Delay time measurement using an IBM PC/XT/AT as controller with Tek's Time and Amplitude Measurement Software. Instruments: the Tek 7D20 Programmable Digitizer and Tek 7603 oscilloscope.



Automated pulse parameter analysis using a Tek 4041 Controller and Tek Time and Amplitude Measurement Software to direct the efforts of the 7D20 in a 7603 mainframe. Hard copy generated by a Tek 4695 Color Copier.



Computing and displaying frequency domain data (FFT), using an HP Series 200 Technical Computer as controller. Tek software for these results accommodates the HP Series 200 with the Tek 7D20 or the Tek 7854 Waveform Processing Oscilloscope.



Editing a Tek 7854 RPN program, including comments, for downloading to the 7854 or archiving to disk. Performed with the HP 200 Series Technical Computer, the Tek 7854, and Tek 7854/HP Series 200 Software. Similar facility available in COMMUTE.

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Japanese electronics firms have stormed the US semicustom-IC market. To survive Japanese encroachment, US semicustom-IC vendors must exploit the distinguishing characteristic of semicustom ICs—customer involvement in product design—and they must act now.

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Transputers are designed for ease of engineering. All transputer family devices operate from a single 5 MHz clock input, which is used to derive high speed internal clocks for all on chip systems.

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The configurable memory controller also requires no external components. It provides all the necessary timing and refresh signals for memory systems, comprising any mix of ROM, SRAM, DRAM and memory mapped peripherals.

Transputers are designed for ease of programming. INMOS offers development systems which provide integrated editing, compiling and source level debugging for both single and multiple transputer applications, using C, Pascal, Fortran and occam.

In applications requiring only a single computing element, the transputer's speed, minimal support component requirements and programming efficiency provide significant cost/performance advantages over conventional microprocessors.

Systems of any size can be built from interconnected transputers, using the links. The same program can be configured to run on one, tens or thousands of transputers allowing a simple trade off between performance and cost.

The transputer family already includes 32 bit and 16 bit transputers, peripheral controllers, evaluation boards and development tools. Start assessing its capability for yourself now with an IMS T414 evaluation board.

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IMS T212	**16 Bit, 2 Kbyte RAM, 4 Transputer links**
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IMS C002	Transputer Link Adaptor, Multiplexed 8-Bit input/output

DEVELOPMENT TOOLS	
IMS D100	INMOS Transputer Development System
IMS D600	Transputer Development Software, VAX-VMS
IMS D700	Transputer Development Software, IBM-PC

EVALUATION BOARDS	
IMS B001	Double Eurocard, IMS T414, 64 Kbyte RAM, 2 x RS232C ports
IMS B002	Double Eurocard, IMS T414, 2 Mbyte RAM, 2 x RS232C ports
IMS B004	IBM-PC add on card, IMS T414, 1 Mbyte RAM

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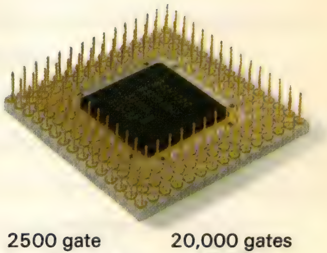
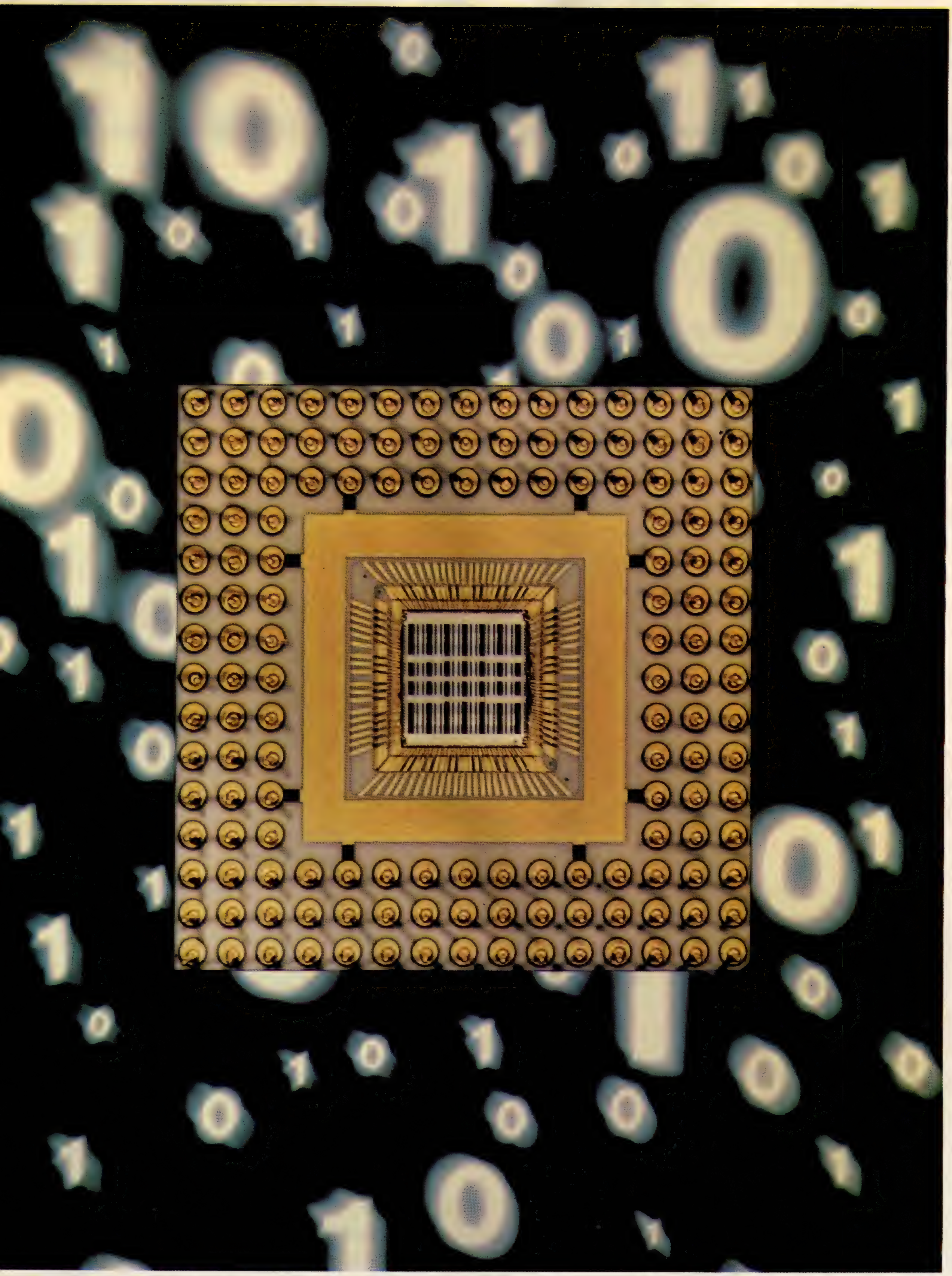


2500 gate functions and 0.35 ns gate propagation delay on a chip area of 75 mm^2 is what we do today. And we're already working on gate arrays with 9000 gate functions and 0.2 ns propagation delay in OXIS III technology on 130 mm^2 area. What we're envisaging? 20,000 gates and 0.05 ns on 300 mm^2 with conductor path spacings of 1 μm and more than four metallization layers in OXIS IV/V technology.

Mainframes are getting more powerful all the time. We use the synergetic effect of in-house applications. That's why we build the fastest gate arrays in the world. The quality and reliability of our components have put us among the leaders in Europe.



Gate arrays from Siemens are in a hi-tech class of their own. With path spacings of 1 μm and 9000 gate functions combined on a 130 mm^2 chip. Siemens has shown and gone new ways in the development of gate arrays.

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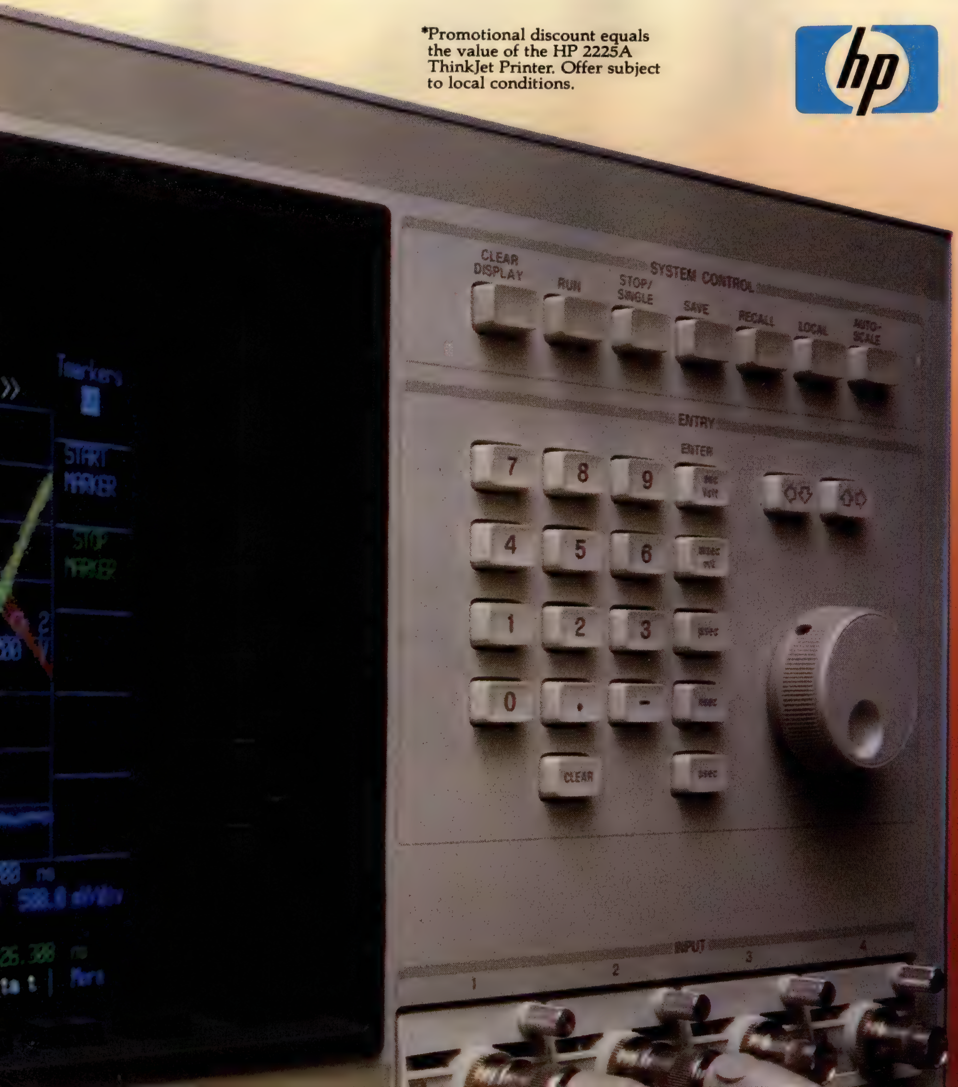
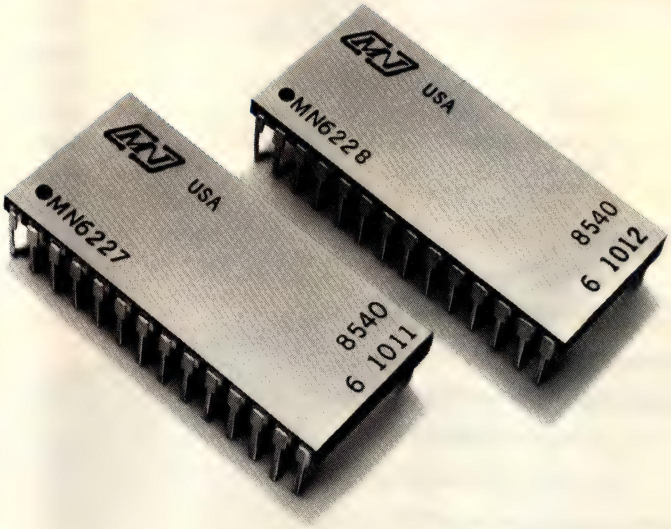


33kHz 12-BIT DSP A/D's

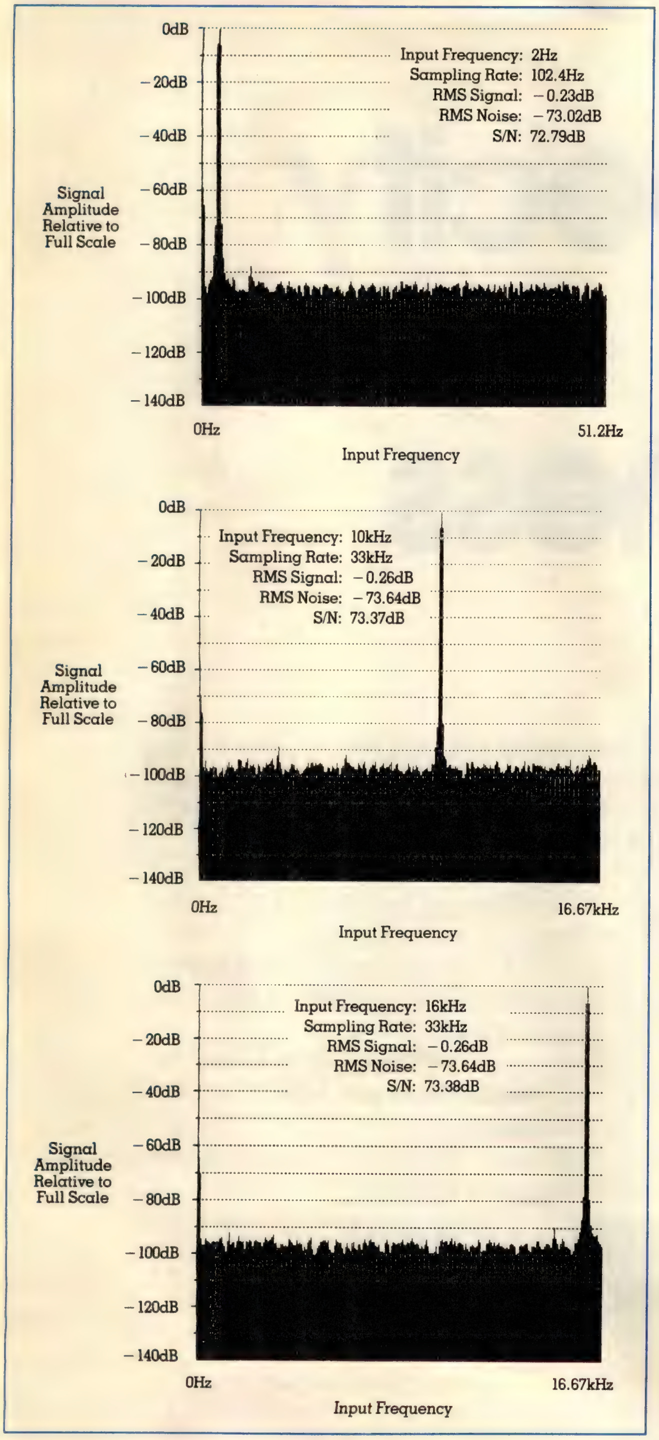


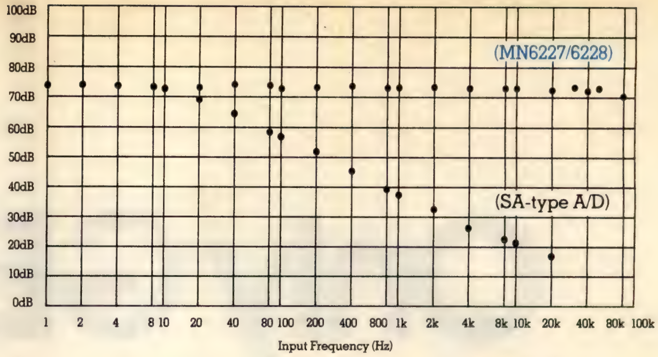
MN6227/MN6228

12-Bit Sampling A/D's
Sampling Rate: 33kHz Minimum
Input Bandwidth: 16.5kHz Minimum
Testing: Frequency Domain (FFT)
Signal-to-Noise Ratio: 70dB Minimum
Harmonics: −80dB Minimum
Price: $74/100's

You are looking at the *first* commercially-available, *FFT-tested*, high-speed, 12-bit, sampling A/D converters *specified* for digital-signal-processing applications. MN6227 and MN6228 are 33kHz A/D's with internal track-and-hold amplifiers. They are ideally suited for radar, sonar, spectrum and vibration analysis, voice and signature recognition, and other contemporary DSP applications. Unlike traditional successive-approximation A/D's without track-hold amplifiers, these true sampling A/D's maintain near-ideal signal-to-noise ratios independent of increasing analog input frequencies. They are *made* for the frequency domain.

Note the FFT spectra (right) and the data plot (top right). They clearly demonstrate the ability of these devices to maintain SNR with increasing input frequencies. In our frequency-domain testing, these devices operate in a manner that simulates a digital spectrum analyzer with a known low-distortion input signal. The output spectra yield precise, practical measurements of signal level, noise level, signal-to-noise ratio, harmonic distortion, and input bandwidth… the keys to specifying for DSP applications.





This plot of actual recorded data demonstrates MN6227/6228's ability to maintain near-ideal SNR with increasing input-signal frequency, while A/D's without companion track-holds show rapid (6dB/octave) SNR degradation.

MN6227/6228 are the first A/D's in our new MN6000 series. The 12 and 16-bit converters in this series all contain internal, user-transparent, track-hold amplifiers that enable each device to accurately sample and digitize dynamically changing input signals with frequency components up to the Nyquist frequency (one-half the sampling rate).

MN6227/6228 have a full 8 or 16-bit µP interface and are packaged in small, low-profile, 28-pin ceramic DIP's, with the industry-standard MN574A pinout.

For detailed information on MN6227/6228, send for our comprehensive data sheet. For rapid response and a copy of our 384-page catalog of data conversion products, call Bob LeFort at (617) 852-5400, x297.

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Worcester, Massachusetts 01606
(617) 852-5400

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Advancing Data Conversion Technology

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A DIVISION OF **UNITRODE** CORPORATION

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CIRCLE NO 20

Only GE dares specify MOSFET ruggedness like this

COMMODITY MOSFET PART NUMBER	GE RUGGED MOSFET PART NUMBER	SPECIFIED AVALANCHE ENERGY (mJ) @ RATED I_d
IRF450	GF6E13	750 mJ
IRFP450	GF8E13	750 mJ
IRF350	GF6D15	700 mJ
IRFP350	GF8D15	700 mJ
IRF250	GF6B30	500 mJ
IRFP250	GF8B30	500 mJ
IRF840	GF4E8	450 mJ
IRF440	GF6E8	450 mJ
IRF740	GF4D10	400 mJ
IRF340	GF6D10	400 mJ
IRF640	GF4B18	300 mJ
IRF240	GF6B18	300 mJ
IRF830	GF4E4	220 mJ
IRF430	GF6E4	220 mJ
IRF730	GF4D5	200 mJ
IRF330	GF6D5	200 mJ
IRF150	GF6A40	150 mJ
IRFP150	GF8A40	150 mJ
IRF630	GF4B9	150 mJ
IRF230	GF6B9	150 mJ
IRF820	GF4E2	120 mJ
IRF540	GF4A27	100 mJ
IRF140	GF6A27	100 mJ
IRF720	GF4D3	100 mJ
IRF620	GF4B5	85 mJ
IRF530	GF4A14	50 mJ
IRF130	GF6A14	50 mJ
IRF710	GF4D1	45 mJ
IRF610	GF4B2	30 mJ
IRF520	GF4A8	25 mJ
IRF510	GF4A4	10 mJ

Note. GE Rugged MOSFETs are also available in 4-PIN DIP and TO-39 packages.

GE first identified MOSFET ruggedness, and is now your only supplier to meet it head-on. All GE Rugged MOSFETs are 100% tested to specified energy ratings. No other MOSFET supplier publishes these ratings.

Only GE Rugged MOSFETs have specified avalanche energy ratings that can add a new dimension of reliability to your systems.

Check the chart for the commodity MOSFET you're using; then select the GE Rugged MOSFET with the specified energy rating.

Sample GE's Rugged MOSFETs and judge for yourself how much more reliable your systems can be. All ratings are available now.

For more information contact GE Semiconductor, 318 First Street, Liverpool, NY 13088.

Call 800-626-2001
Ext 400

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CIRCLE NO 21

NEWS BREAKS

EDITED BY JOAN MORROW

PROGRAMMABLE PROTOCOL ANALYZER MONITORS IEEE 802.3 NETWORKS

The 4971S LAN protocol analyzer from Hewlett-Packard (Palo Alto, CA) provides developers and users of IEEE 802.3 (Ethernet) products a programmable tool for monitoring network traffic and performance. Operation of the 4971S is similar to a logic analyzer. You can define as many as 16 filters that selectively capture, time stamp, and store data packets in a 1M-byte buffer. Filters devote 14 bytes for source address, destination address, and type or length fields. You can designate an additional 47 bytes within the data field for a filter, as well as maximum and minimum packet length. A soft-key-driven programming language provides for multilevel filtering, event timing, packet counting, and response triggering from a 16-message transmit buffer. You can give 500 node addresses mnemonic names to improve display readability, and you can name user-defined fields within the data field. This last feature is useful for higher-level protocols such as TCP/IP. The 4971S with protocol analyzer, display, keyboard, and dual 3½-in. floppy-disk drives costs $30,000.—Steven H Leibson

DMOS PROCESSING ENGENDERS HIGH-VOLTAGE MOSFETs

A line of power MOSFETs from Ixys Corp (San Jose, CA, (408) 435-1900) uses a process the company calls HDMOS (high-performance DMOS) to attain voltage-blocking capabilities of 450 to 1000V at rated currents from 2 to 15A. The company's process makes use of a proprietary cell layout that reduces parasitic-bipolar-transistor effects. These parasitic elements are the major cause of power-MOSFET failure under inductive-load conditions. The manufacturer claims its devices feature on-resistance values that are 15 to 30% lower than those of competitors' 800V units. The MOSFETs come in three series: The IXTM Series is housed in a TO-3 metal package; the IXTH Series uses a TO-3P (TO-247) plasic package; and the IXTP Series comes in the lower-power TO-220 package. Prices are competitive with those of equivalent models from other manufacturers.—Bill Travis

CMOS LOGIC FAMILY FEATURES SCHOTTKY SPEED, LOW POWER

Texas Instruments, Philips, and Signetics will jointly develop and manufacture a family of CMOS standard-logic ICs that operate faster than other CMOS ICs and yet dissipate no additional power. The 1-μm Advanced CMOS Logic (ACL) devices, the first of which will be available this month, will be comparable in speed to advanced Schottky components, with average gate delays of less than 3 nsec and operating clock frequencies as high as 150 MHz. The devices will also overcome output limitations of existing products; with 24 mA of output-drive current (compared to 4- to 6-mA output for HCMOS), they will be able to propogate logic-level signals through a system's backplane.

The ACL family will include both CMOS- and TTL-compatible devices. The first available parts will include versions of 7400/5400 NAND gates, 7474/5474 D-type flip-flops, and 74245/54245 3-state bus transceivers. More than 100 other logic functions will be available by the end of the year, according to the companies. Prices haven't been set for the parts, but TI and Signetics say prices will probably equal those of existing products after about two years during which production volume will increase.—Gary Legg

COMPANY OFFERS ALTERNATIVE TO OFFSHORE-PRODUCED CORES

A newly formed company, Advanced Memory Technology Inc (Van Nuys, CA, (818) 785-0479), produces ferrite cores for manufacturers of high-reliability military memory systems. According to the company, many military programs specify core memories for nonvolatile read/write operations, especially in systems requiring radiation hardness. The cores come in industry-standard sizes of 13, 14, 18, and 22 mils; in addition, a special family designated NDRO (nondestructive readout) is suitable for radiation-hardened systems. The manufacturer claims design and packaging advances make core memory volumetrically competitive with floppy-disk drives. For example, a MIL-qualified airborne memory of 256k bytes fits in a 6×9×1-in. envelope.—Bill Travis

VIDEO TIMING CONTROLLER ACCOMMODATES 125-MHz CLOCK RATE

A programmable video timing controller from Advanced Micro Devices (Sunnyvale, CA, (408) 732-2400) finds application in high-resolution (1000×1000 pixels or more) bit-mapped graphics systems. Model Am8158 accepts clock rates to 125 MHz; the IC has nine programmable registers that contain the timing parameters for the generation of control signals. The device generates the necessary synchronization signals for a CRT display and other devices in a graphics system. By initializing the nine programmable registers during power-up, you can tailor the unit for your system design. Programmable parameters include number of pixels per memory access, number of memory accesses per scan line, number of scan lines per frame, and pulse widths of the synchronization signals for the CRT monitor and the system. In a 28-pin ceramic DIP, the device costs $38.60 (100).—Bill Travis

CURRENT-MIRROR MOSFET PROVIDES LOSSLESS CURRENT SENSING

By providing access to a few source cells (of its many thousands), the Sensefet power MOSFET from Motorola (Phoenix, AZ, (602) 952-3000) allows you to sense the current flowing in the device's load, without the necessity of placing a power-wasteful resistor in the load path. You can measure the current flowing in the sense cells by placing a resistor from the sense-cell terminal to the negative load return. This current represents the current conducted by the power MOSFET, divided by the ratio (about three orders of magnitude) of active cells to the number of sense cells. The device, designated Model MTP10N10M, is a 100V, 10A MOSFET that specs 0.25Ω on-resistance. Housed in a 5-lead TO-220 package, the MTP10N10M costs $1.65 (100).—Bill Travis

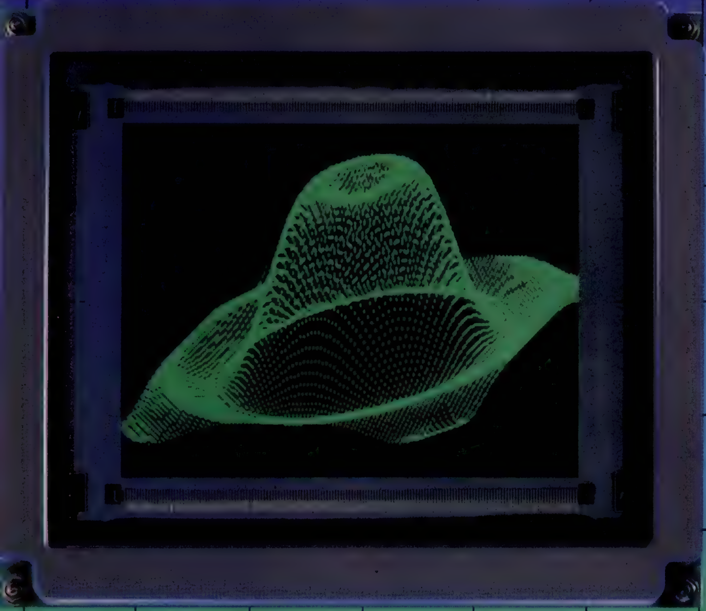
NEW CAT/CAM PRODUCTS WILL HIGHLIGHT ADEE

Product introductions will highlight the Automated Design and Engineering for Electronics show (ADEE), which will be held at the Moscone Center in San Francisco, CA, from March 11 to 13. For instance, LPKF Pacific (Novato, CA) will display its ColorCam system, which fabricates pc boards directly from schematics. To use the pc-board production system, you enter a schematic of your single- or double-sided pc board into an IBM PC, and the product automatically mills and drills the board. The complete system costs $35,000; you can purchase the software separately for $8700.

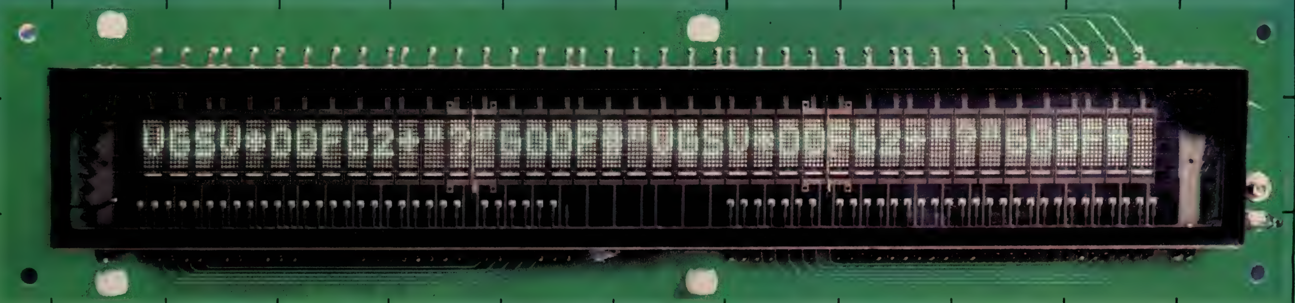
A dc parametric-measurement unit (PMU) will enhance Integrated Measurement Systems' Logic Master series of application-specific-IC verification systems. The PMU measures input current, output voltage levels, output drive capability, and input voltage-level sensitivity. An automeasurement feature repeats test sequences on every pin of a device and flags pins that fail to meet your specs. The measurement unit costs $19,200 for a 192-channel model; the 384-channel version costs $31,200.—Eva Freeman

Clear and Bright

Vacuum Fluorescent Technology



Graphic Module



Dot Module

EATURES

High resolution and high brightness provides excellent appearance and quality.

Light weight and thin package permits compact design.

TTL compatibility provides easy interface and self-test and brightness control are standard features.

Graphic Module Series List

Type code	Number of Pixels row × column	Pixel Pitch mm	Effective Display Area mm	System	Alphabetic Display digit × col
GP1005	128 × 64	0,65	83 × 41,4	VFD	20 × 6
GP1006	256 × 64	0,65	166 × 41,4	VFD	40 × 6
GP1009	240 × 64	0,45	107,9 × 28,7	VFD	40 × 6
GP1001	320 × 120	0,375	120 × 45	FLVFD	52 × 12
GP1002	320 × 240	0,375	120 × 90	FLVFD	52 × 24

quire for single color Graphic Module

Dot Module Series List

Type code	Characters × Line	Dot Construction	Character Size	Nos. of displaying characters
M20SD01CA	20 × 1	5 × 7 dot	3.5 × 5.0	222
M20SD42CA	20 × 1	5 × 12 dot w/cursor	3.5 × 8.75	222
M40SD02CA	40 × 1	5 × 7 dot w/cursor	3.5 × 5.0	222
M40SD42CA	40 × 1	5 × 12 dot w/cursor	3.5 × 8.75	222
M202SD03CA	20 × 2	5 × 7 dot w/cursor	3.5 × 5.0	222
M402SD04CA	40 × 2	5 × 7 dot w/cursor	3.5 × 5.0	222

Inquire for single color Dot Module

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CIRCLE NO 24

CIRCLE NO 23

NEWS BREAKS: INTERNATIONAL

EDITED BY JOAN MORROW

JAPANESE COMPANY TO IMPORT US PARALLEL COMPUTERS

Under a joint agreement between Matsushita Electric Trading Co Ltd (Osaka) and Sequent Computer Systems (Beaverton, OR), Matsushita will be the sole agent to import and distribute Sequent's parallel-processing computer systems in Japan. The Balance 8000 and 21000, which will be imported by a Matsushita subsidiary, include two to 30 tightly coupled NS32032 32-bit processors. The μPs share a common memory and one copy of Dynix, Sequent's enhanced version of Unix.

LOW-COST, SINGLE-CHIP MODEM DESIGNED FOR PERSONAL COMPUTERS

A single-chip modem developed by Nippon Electric Co should cost about half as much as conventional modems when it is introduced later this year. NEC will initially set the price at approximately ¥100,000 ($488); the company also believes that it can further reduce the device's cost in 1987. A comparable modem usually costs approximately $980.

MITSUBISHI MAKES NEW STATIC RAMs, TO SHIP 1M-BIT DRAMs

The Model M5M5256P, a 256k-bit static RAM from Mitsubishi Electric Corp, is a 32k×8-bit CMOS device that comes in 100-, 120-, and 150-nsec versions. Sample prices for the devices, which were fabricated under a 1.3-μm design rule, are ¥10,000 ($48.78) to $68.30. A 64k-bit static RAM, the Model M5m5518XP, is organized as 64k×1 bit and 16k×4 bits and features a 45-nsec access time. Sample price is $39.

The company is also planning to ship the first samples of its 1M-bit dynamic RAM starting this spring. Five other Japanese companies have already begun sampling 1M-bit devices: NEC, Fujitsu, Matsushita, Toshiba, and Hitachi.

SEVEN-COLOR PRINTER WILL RUN AT 180 CPS

Nippon Kinsen Kikai, a cash-register manufacturer, will enter the color-printer market with a 7-color machine that will print at 180 cps. The manufacturer plans to aim the machine at American and European OEMs. The printer should cost approximately ¥50,000 ($244) when the mass-production facility is completed.

CMOS 8085A-TYPE MICROPROCESSOR OPERATES AT 5 MHz

The MSM80C85A-2, a CMOS version of the 8085A-type 8-bit μP, operates at 5 MHz and draws less than 20 mA. Manufactured by Oki Semiconductor under license from Intel Corp, the μP features a 50-mW typ power dissipation. Power-down current is less than 7 mA, compared with 170 mA for NMOS types. The device costs $7.30 (100) and comes in a 40-pin plastic DIP or 44-pin plastic flat package.

NEC TO ENTER EEPROM MARKET

Nippon Electric Co is expected to enter the EEPROM market during the first half of this year with a 64k-bit device. Other Japanese companies involved in the EEPROM market include Hitachi Ltd and Oki Electric; Mitsubishi is also planning to introduce an EEPROM in the near future.

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CIRCLE NO 25

UNBELIEVABLE!

Model PLP

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or Microwaves Directory

F82-1 REV. ORIG.

Model PHP

FILTERS from 9^{95} IN STOCK

- from dc to 3GHz

- less than 1dB insertion loss over entire passband
- greater than 40dB stopband rejection
- 5 section, 30dB per octave roll-off
- VSWR less than 1.7 (typ)
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Pass Band, MHz (DC–)	48	98	140	190	270	400	520	580	700	780	900
20dB Stop Band start from	70	135	210	290	410	580	750	800	1000	1100	1340

HIGH PASS **Model PHP**		**–50**	**–100**	**–150**	**–200**	**–300**	**–400**	**–500**	**–600**	**–700**	**–800**	**–900**	**–1000**
Passband, MHz	start	41	90	133	185	290	395	500	600	700	780	910	1000
	stop	200	400	600	800	1200	1600	1600	1600	1800	2000	2100	2200
20dB Stop Band, (MHz) from DC to		26	55	95	116	190	290	365	460	520	570	660	720

CIRCLE NO 26

F82-2 REV. ORIG.

Design in TI's new

The new IBM® Token-Ring Network promises to become the industry standard. And if you are wondering about the best and quickest way to tie your product into this new 4-Mb/sec LAN, here's your solution: **The TMS380 chip set from Texas Instruments.**

TI's TMS380 is the *only* commercial chip set tested — and system-verified — by IBM. It's *the* silicon standard for this new high-speed office-system LAN.

And for a sure, fast entry into this exciting new market, you can begin with TI's TMS380 *Design-in Accelerator Kit.*

Q. What kinds of products can communicate through the new LAN?

A. With the TMS380 chip set, almost any.

TI's new TMS380 chip set was developed jointly with IBM. Its general-purpose system interface allows many kinds of equipment from various manufacturers to communicate through the IBM Token-Ring Network. And since this is an open network, any product in which you use the TMS380 can communicate with any other, when common languages are used.

Q. Is expensive cabling required?

A. No.

Your customers have the option of using telephone twisted pair or shielded twisted pair. And the point-to-point topology of the token ring makes it ideal for fiber optics, since the taps that are necessary with bus topologies are not required.

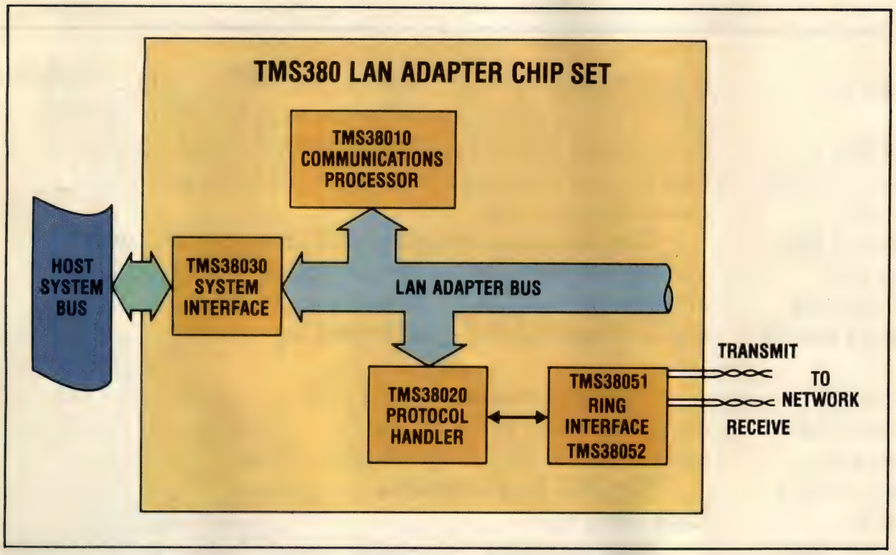
Q. Where does TI's TMS380 chip set fit in?

A. It's the heart of your LAN adapter card or subsystem.

The TMS380 chip set is a complete solution for the physical interface and media-access control. Its integrated LAN-adapter architecture provides for efficient, transparent handling of the IEEE 802.5 protocols. TI's TMS380 in your product will give your customers freedom to choose the cabling system that best suits their needs. And the flexibility to interface with any of the popular logical-link-control and higher-layer protocols.

◀ **Everything you need** to begin designing your own IBM Token-Ring Network LAN adapter is included in your TI *Design-in Accelerator Kit:* Three TMS380 chip sets, comprehensive literature, and debug software.

IBM compatibility with token-ring-LAN chip set.


TMS380 LAN ADAPTER CHIP SET
TMS38010 COMMUNICATIONS PROCESSOR
HOST SYSTEM BUS
TMS38030 SYSTEM INTERFACE
LAN ADAPTER BUS
TRANSMIT
TO NETWORK
RECEIVE
TMS38020 PROTOCOL HANDLER
TMS38051 RING INTERFACE TMS38052

Five TMS380 chips form the heart of your LAN adapter. The TMS38030 automatically manages the interface between system memory and the adapter. The TMS38010 processes and buffers data. The TMS38020 contains RAS and LAN-management software and handles data in accordance with IEEE 802.5 protocols. And the TMS38051 and TMS38052 monitor cabling integrity, control network insertion, and perform clocking and signal conditioning.

Q. What about network management?

A. Every service your system needs is built in.

TI's new TMS380 chip set includes "self-healing" features that ensure the reliability, availability, and serviceability (RAS) of the network. And *only* the TMS380 chip set has them.

Among these special features are fault isolation of cable-system failures, error reporting, self-test diagnostics, and LAN-management services. So you're relieved of the risk, time, and expense of developing custom hardware and software for these essential functions.

Q. Can it grow with my needs and my customers'?

A. Yes.

On-chip RAS and LAN-management software make TI's TMS380 chip set completely compatible with the IBM Token-Ring LAN and give it a stable foundation to meet the need for future network expansion. As higher performance standards develop, the TMS380 chip set will accommodate them.

Q. Is training available from Texas Instruments too?

A. Yes.

A three-day workshop on the TMS380 is available at TI's Regional Technology Centers. It includes an introduction to the TMS380 chip set, and hands-on experience in the lab. For information on schedules and reservations, call your TI Field Sales Office or the TI Regional Technology Center nearest you *(list at right)*.

Q. Sounds good, but where can I get more details?

A. From your TI Field Sales Office or authorized distributor.

Ask for the TMS380 Product Description.

Q. What's this about an Accelerator Kit?

A. It's your head start to IBM token-ring compatibility.

TI's *Design-in Accelerator Kit* will give you a head start on designing IBM Token-Ring Network compatibility into your products. It includes three chip sets, the *TMS380 User's Guide,* and the *Token Ring Adapter Bring-Up Guide* with debug software. Order yours before March 31 from your nearby TI Field Sales Office or authorized distributor, and get a token good for free admission to TI's three-day TMS380 workshop.

27-5278
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There are some things man was not meant to tamper with.

Semicustom circuits, for example. If you happen to have second thoughts about your design, you're powerless to do anything about them. Unless you have the luxury of lots and lots of time and money. But when you're trying to get your products to market before the competition, extra time is something you rarely have, and extra money is something you *never* have.

Fortunately, there is help: Programmable Logic Devices from Signetics. With Signetics PLDs, you can make all the changes and tweaks you like—without losing precious time. So you reduce the risk of completing your design after it's too late to compete effectively in the marketplace.

What makes Signetics PLDs the most flexible, most complete, best-supported PLD series in the industry? A unique approach to sequencer architecture, for one thing.

It not only simplifies state machine designs but also cuts the time it takes to build them.

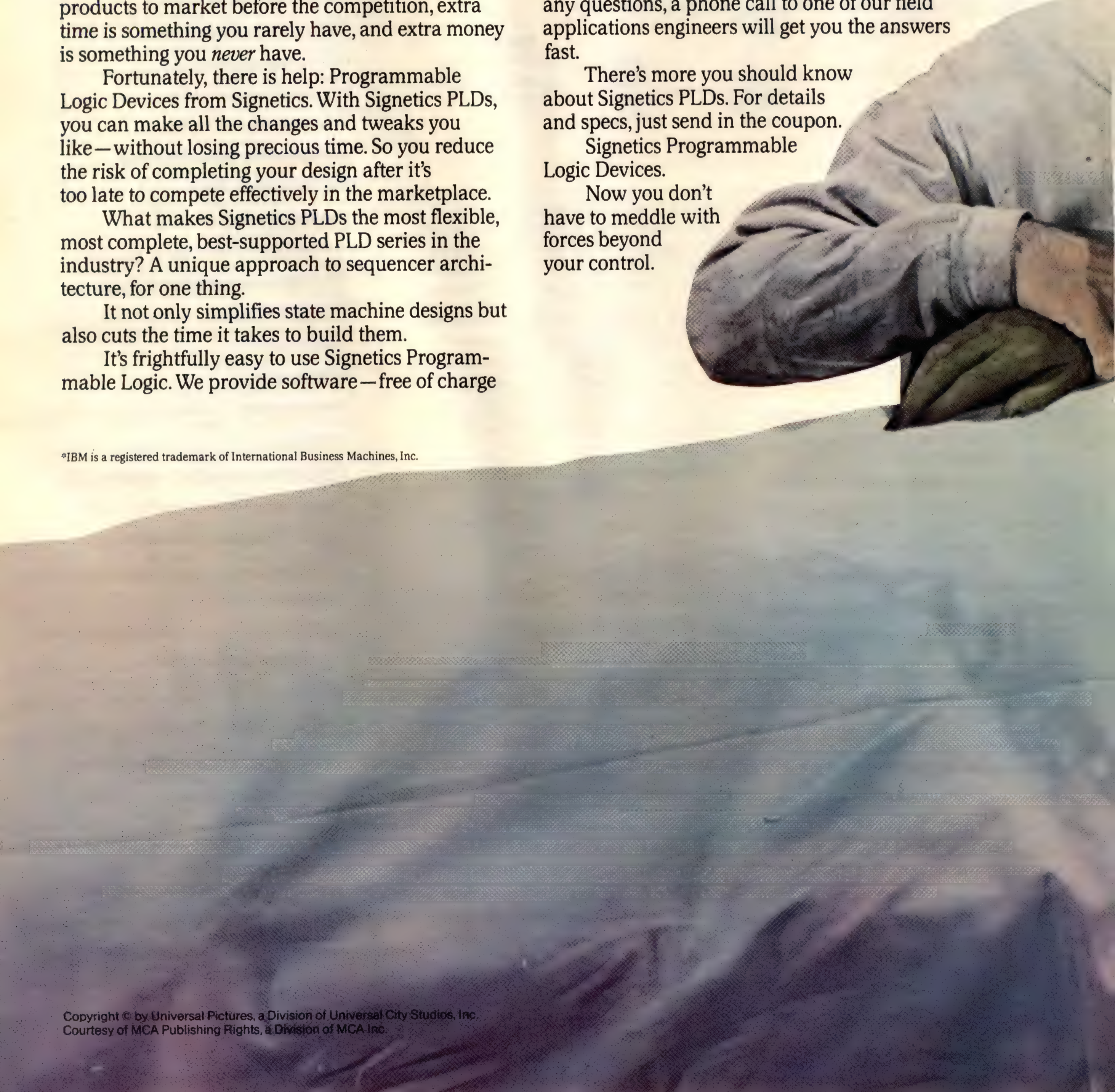
It's frightfully easy to use Signetics Programmable Logic. We provide software—free of charge to qualified users—that turns an IBM* PC into a PLD work station. The work station helps you to define your function in terms of a Boolean equation or state transfer expression; then you use the output to program the fuses, and your circuit is ready to go.

Complete documentation and design simulation let you perfect your ideas to the nth degree. And if you have any questions, a phone call to one of our field applications engineers will get you the answers fast.

There's more you should know about Signetics PLDs. For details and specs, just send in the coupon.

Signetics Programmable Logic Devices.

Now you don't have to meddle with forces beyond your control.



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Yes, I'd like to know more about Signetics PLDs. Rush me the specs ASAP.

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CIRCLE NO 28

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YOU'RE IN CONTROL*!

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* con·trol (kŏn-trohl) n. a standard of comparison for checking the results of an experiment or industrial process.

We understand setting the standard of comparison is your business. Our business is to provide you with a wide variety of high quality controllers for your experiments and industrial applications.

With FORCE, you easily control . . .

. . . multi processing environments with our ASCU series of Advanced System Control Units, which offer IEEE 488 interface and 4-level bus arbitration.

. . . high resolution color displays (944 x 764 pixels) with our GDC intelligent graphics controller, which allows up to 2048 different colors.

. . . color or monochrome monitors with our CMC intelligent terminal controller, which features various interfaces and supports keyboard and lightpen.

. . . interfacing into high noise industrial environments using OPIO, the opto-isolated parallel I/O board with DMA.

. . . disk memories with our WFC multiple Winchester and Floppy controller with error correction.

. . . SASI interfaces with our intelligent SASI host adapter.

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CIRCLE NO 29

SIGNALS & NOISE

NiCd-battery test drains batteries

Dear Editor:

In his Design Idea "Circuit lets you analyze NiCd batteries" (EDN, September 5, 1985, pg 301), Mike Scaglione accurately states a problem that faces many engineers: the difficulty of determining the charge remaining on NiCd batteries. I consider his solution, however, to be of no practical value. Although he does accurately determine how much charge the battery had at the beginning of the test, he completely uses up the charge by the end of the test. What good is such a test to the engineer who's depending on the battery for a backup power source? If you have to destroy the remaining charge in order to measure it, you haven't solved the problem.

Sincerely yours,
Robert F Helfinstine PE
Principal Systems Engineer
Honeywell Inc
Commercial Aviation Div
St Louis Park, MN

Author's reply

Dear Editor:

The Design Idea entitled "Circuit lets you analyze NiCd Batteries" was not intended to be used to determine the remaining charge on a NiCd battery. Instead, you use this circuit to determine whether the battery has the capacity the manufacturer specifies. Many factors—such as discharging to the point of polarity reversal, use at extreme temperatures, excessive charge or discharge currents, and repeated, partial discharging that results in a memory effect—can reduce the useful capacity of a NiCd battery.

To determine a battery's capacity accurately, you must remove the battery from the circuit, charge it completely, test it, and then recharge it. The test circuit in my Design Idea is particularly useful to engineers who must test large numbers of NiCd batteries on a continuing basis.

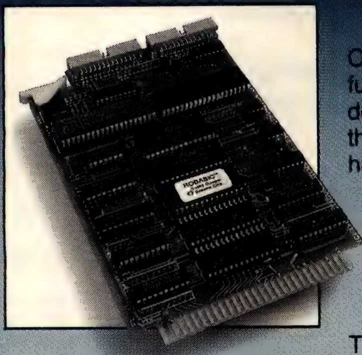
Sincerely yours,
Michael Scaglione
Director of Engineering
Todd Medical Inc
North Canton, OH

YOUR TURN

EDN's Signals and Noise column provides a forum for readers to express their opinions on issues raised in the magazine's articles or on any topic that affects the engineering industry. Send your letters to the Signals and Noise Editor, 275 Washington St, Newton, MA 02158. We welcome all comments, pro or con. All letters must be signed, but we will withhold your name upon request. We reserve the right to edit letters for space and clarity.

Multitasking BASIC...

for real-time STD Bus control.



Octagon's NEW 880B Multifunction CPU is a system designer's dream card. With the built-in software and hardware features, the 880B can be a stand-alone control system. Just connect a terminal, turn on the power and you are ready to program.

The resident ROBASIC™ software is more than BASIC. This fast, compiled language lets you write your programs right on the card. The ROMmable code executes automatically on power up. 73 of the 140 commands talk to your STD Bus peripheral cards. Supports 16 concurrent tasks which can be called by name. Powerful, yet easy.

The 880B can bring your product to the marketplace long before the competition. No R&D costs, no lengthy learning curve and no specialized personnel.

Features of the 880B card include:

- ROBASIC in 32K ROM
- 8088 processor
- 80K on card memory
- Real-time clock
- 2 RS-232C serial ports
- 16 parallel I/O channels
- 9 prioritized interrupts
- 5 counter/timers
- STD Bus compatible
- **$595**

For more information call **303-426-8540.**

OCTAGON SYSTEMS CORPORATION
6501 W. 91st • Westminster, Colorado 80030

CIRCLE NO 30

If your system is only using this many colors, isn't it time to grow up?

The INMOS IMSG170 Color Look-up Table offers a grown-up solution to video display color enhancements. It lets you and your RGB analog display advance to a palette of more than a quarter million colors.

This programmable DAC conforms to RS170A standards with pixel rates up to 50 MHz, in a 28 pin package.

And to simplify things, the table integrates the functions of a 256 word x 18 bit color mapping table, three 6-bit DACs, 75 ohm drivers and microprocessor interface into a monolithic CMOS device. The result? Reduced board space and power consumption at a lower cost.

The Color Look-up Table from INMOS. Designing with thousands of colors just became child's play.

INMOS Corporation, Colorado Springs, Colorado, Tel. (303) 630-4000
Bristol, England, Tel. 0272-290-861
Paris, France, Tel. (1) 687-2201
Munich, Germany, Tel. (089) 319-1028

inmos

Compare your computer design colors to these crayons. If the crayons win, call INMOS.

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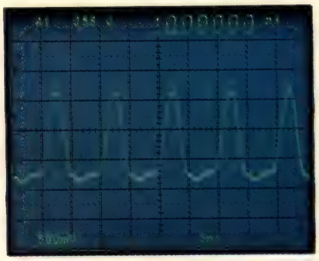
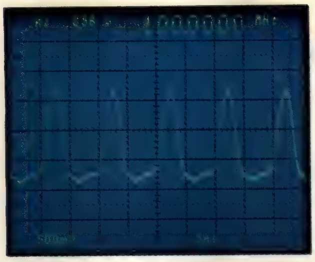
CIRCLE NO 31

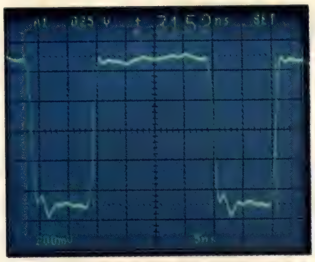
SIXTEEN TOUGH ASSIGNMENTS.



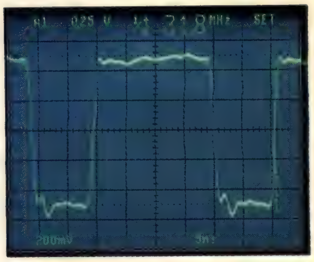
A period measurement is made on a 100 MHz clock using the extended accuracy and resolution of the Counter/Timer/Trigger in the 2465 DVS.



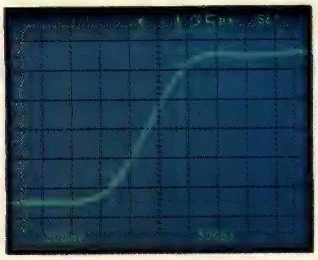
A frequency measurement is made with the same high precision. Simply press two buttons, and the period measurement on the left is converted to frequency.

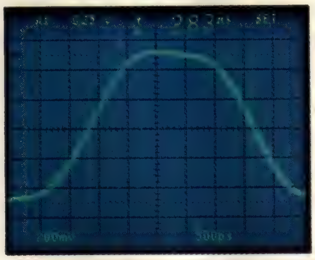


Short time intervals can be measured most accurately with the easy-to-use time cursors. They also make quick work of longer intervals, with 1% accuracy.

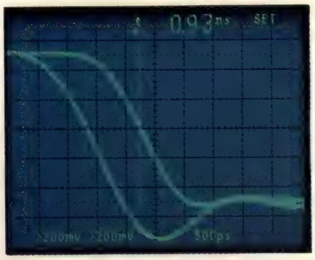


Calculated frequency takes only seconds. The time cursor measurement on the left can be converted to frequency with push-button ease and 1% accuracy.

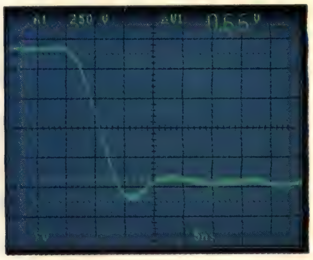




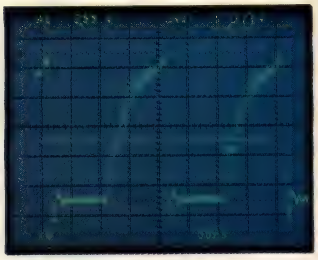
This fast-pulse rise time is nearly that of the scope. The 2465 achieves maximum bandwidth with minimum waveform aberrations. This level of pulse response ensures that **pulse width** and amplitude measurements on fast waveforms (above) truly reflect conditions in a circuit under test.



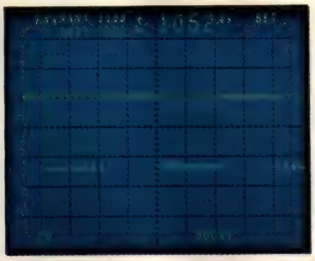
Propagation delay measurement accuracy is assured by built-in propagation delay matching. Delay between Channels 1 and 2 can be corrected to the probe tip.



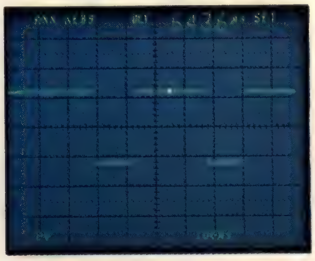
Overshoot and ringing measurement accuracy requires flat response in a probe/oscilloscope system. Tek probes and scopes are designed to work together.



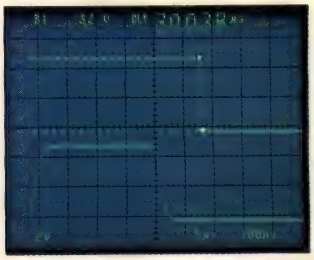
Logic-level violations can be spotted quickly on a TTL waveform (above) with measurement cursors set to define logic-level boundaries.



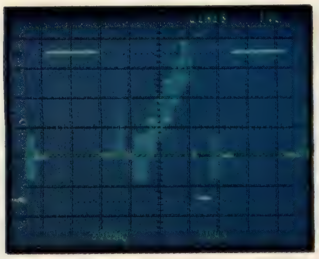
The Word Recognizer (with a binary word) is used to pick out a pulse train in a data stream. The time cursors measure pulse train duration.



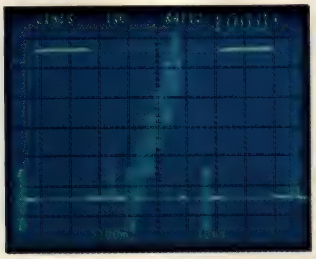
Identify a word position. The Word Recognizer (in HEX) is intensifying a word position and measuring delay relative to a waveform on another line.



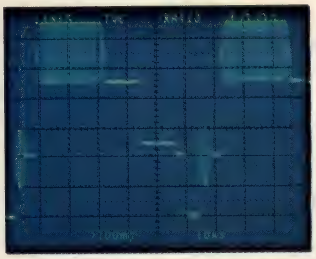
Delayed sweep is used to expand the last pulse in a pulse train. The intensified zone identifies the expanded pulse position.



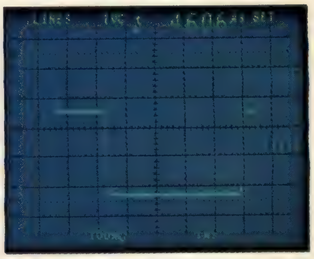
TV line trigger in the 2465 DVS displays a full-field composite test signal. The built-in TV clamp circuit removes hum and tilt on the ac-coupled video.



Calibrate cursors in IRE units with variable attenuation. Blanking level to reference white level is defined as 100 IRE units in NTSC video.



Burst amplitude should be 40 IRE units in NTSC video. The cursors quickly measure other waveform amplitudes. Field triggering checks any line.



Sync width and blanking are common, easy-to-make timing measurements. Accurate time measurements can be made anywhere in a video system.

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FIVE EASY ANSWERS. THE TEK 2400 SERIES.

You can simplify even the most complex measurements with the performance and convenience of Tek's 2400 Series family. No other portable scopes meet such diverse requirements in research and design, manufacturing and service.

The 300 MHz 2465 and 150 MHz 2445 are at the foundation of the family. They include all the features that set a new high performance precedent. For example, standard delayed sweep Δ-Time to 0.5% accuracy. Coupled sweep speeds to 1 ns/div in the 2445 and 500 ps/div in the 2465 for tough timing measurements. And four-channel capability for observing and troubleshooting logic circuits.

Best of all, these stand-alone scopes are proof that powerful capability doesn't have to be complicated. Time and voltage cursors for fast and easy measurements, CRT readouts showing waveform parameters and front panel settings, and simplified trigger operation make these scopes a pleasure to use.

Three specially configured, specially priced Special Editions offer enhanced measurement capabilities for both systems and stand-alone use. At the top is the 2465 DVS with integral GPIB interface, DMM, Counter/Timer/Trigger/Word Recognizer, and Video measurement capabilities. Easily the most powerful portable ever developed.

The 2465 DMS and 2465 CTS are special editions with different feature sets. The 2465 DMS provides all the capabilities of the DVS except Video. The 2465 CTS provides all the features of the DVS except Video and DMM.

Call your Tek Sales Engineer for a demo today! Or call the Tek National Marketing Center toll-free, 1-800-426-2200. In Oregon, call collect, (503) 627-9000.

Features	2445	2465	2465 CTS	2465 DMS	2465 DVS
Bandwidth	150 MHz	300 MHz	300 MHz	300 MHz	300 MHz
Max. Sweep Speed	1 ns/div	500ps/div	500ps/div	500ps/div	500ps/div
Accuracy; Vert/Hor	2%/1%	2%/1%	2%/1%	2%/1%	2%/1%
Vertical Sensitivity	2 mV/div	2 mV/div	2 mV/div	2 mV/div	2 mV/div
Trigger Freq. Range	250 MHz	500 MHz	500 MHz	500 MHz	500 MHz
Trigger Modes	Auto Level, Auto, Norm, Single Sequence				
Counter/Timer/Trigger/Word Recognizer	*	*	STD	STD	STD
DMM	*	*	N/A	STD	STD
Video/TV	*	*	N/A	N/A	STD
Four P6131 Probes	*	*	STD	STD	STD
GPIB	*	*	STD	STD	STD
Rackmount	*	*	*	*	*
Warranty	3-year on parts and labor, including CRT				
Price†	$3590	$5350	$7150	$8400	$9200

Software	
TEK GURU for IBM PC/XT/AT and 2445/65/GPIB	$595
EZ-TEK 2400 for TEK 4041 and 2445/65/GPIB	$400

*Configurable only at time of order. Additional cost required.

†Prices subject to change without notice.

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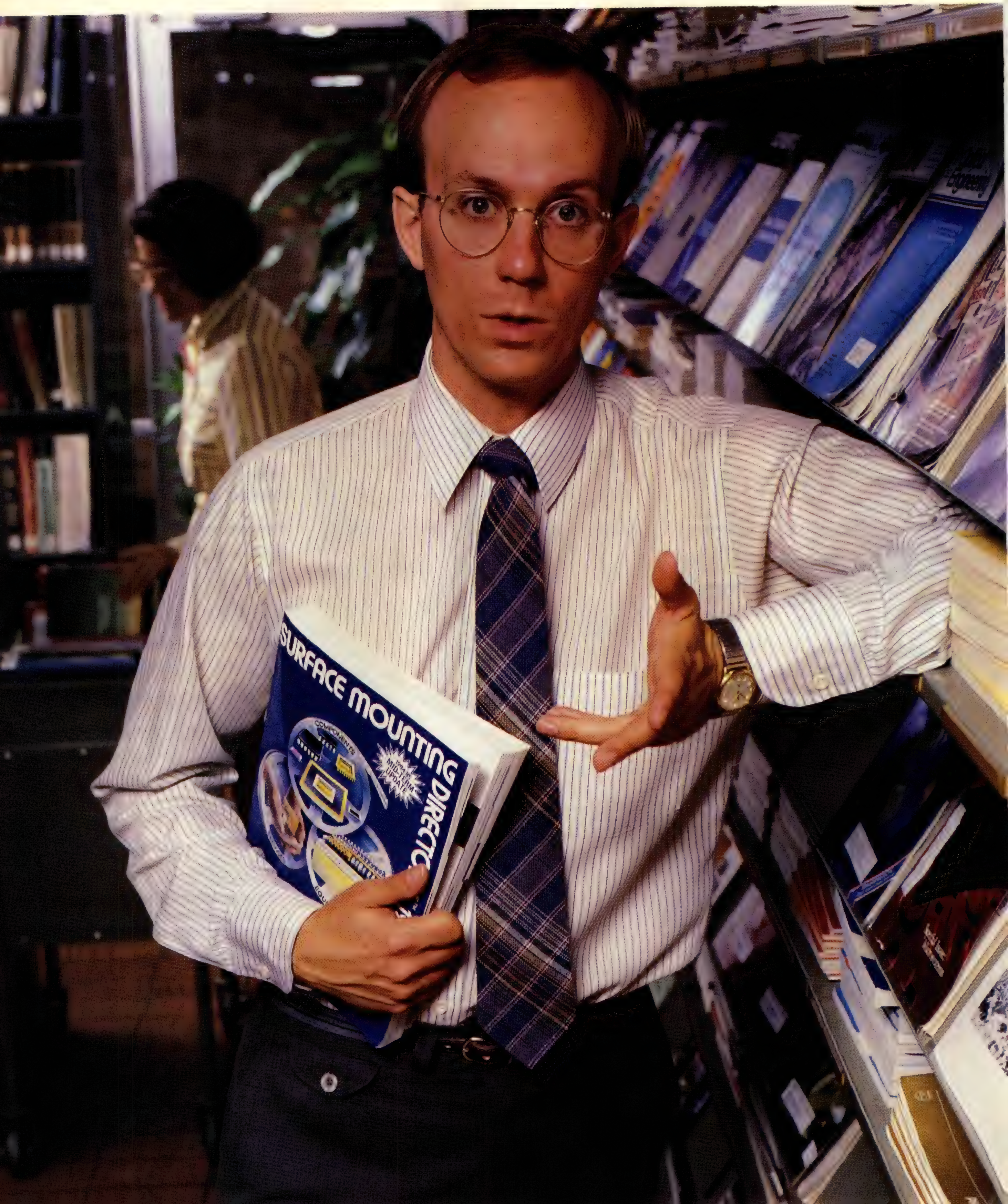
CIRCLE NO 32

"What's new from Texas Instruments?"



1,550 different IC products in surface-mount packages.

SMti SURFACE MOUNT™ TEXAS INSTRUMENTS — TI's Broad Surface-Mount Choice

Package	Designator*	Pins	Linear	Logic	PAL IC, FPLA, PROM, EPROM	Semicustom	DRAM	Microprocessor, Peripheral
SO	D	8	●					
	D	14	●	●				
	D	16	●	●				
	DW	20	●	●	●			
	DW	24	●	●	●			
PLCC	FM	18				●	●	
	FN	20	●	●	●	●		
	FM	22					●	
	FN	28	●	●	●	●		●
	FM	32			●			
	FN	44	●	●		●		●
	FN	68		●		●		●
	FN	84				●		
LCCC	FG	18				●	●	
	FK	20	●	●	●	●		
	FK	28	●	●	●	●		●
	FD	44	●	●		●		●
	FD	68		●		●		●

**See TI package designations overleaf.*

But don't hold us to an exact 1,550. The count is growing almost daily because TI is committed to offering all of its popular ICs in surface-mount packages *(see table above)*.

Right now, that 1,550 includes more than 550 digital bipolar logic devices. Approximately 185 linear circuits — op amps, comparators and timers, line circuits, peripheral drivers, and voltage regulators. Many high-speed CMOS devices. There are ×1 and ×4 MOS DRAMs, plus TI's pace-setting video RAM. FPLAs, IMPACT™ PAL circuits and PROMs, microcontrollers, standard cells and gate arrays. As well as more than 500 military devices. That's a broad enough choice for you to get many designs off the drawing board and into the benefits of surface-mount technology (SMT).

Q. But aren't surface-mount packages a lot more expensive than DIPs?

A. No longer.

Pricing is no longer an obstacle to gaining the many advantages of SMT. In quantity, TI's surface-mount components (SMCs) in small-outline (SO) packages — with pin counts from 8 to 24 — are priced at parity with their DIP counterparts. SO linear and logic devices in lots as small as 1,000, for example, are at resale-price parity with the same ICs in DIPs.

Although many MSI, LSI, and VLSI devices in plastic leaded chip carriers (PLCCs) — with up to 84 pins — are available today at a slight premium, higher-volume production is expected to narrow and ultimately eliminate the difference.

Q. What about my manufacturing costs?

A. They could be greatly reduced.

The switch from conventional through-hole technology to surface mounting will entail capital outlay. And you do have to learn new manufacturing techniques. But in volume production, it has been estimated that overall manufacturing costs can be reduced by as much as 50%.

Q. Are you saying SMT could finally be practical? For me? Today?

A. Yes.

With TI's broad and growing range of SMCs, you can achieve all the advantages of SMT: Increased board density. Improved performance. Reduced package volume and weight. Economies in shipping, storage, and handling. Efficient automated assembly. And yes, you can do it practically, cost-effectively. Now.

Q. So what else do you have for me that's new?

A. Turn the page and see.

SMCs from TI boost disk-drive capacity by 40% for Siemens.

Siemens is packing 40% more capacity into its innovative 5¼-inch Megafile™ Winchester disk drive compared to the previous generation — with no increase in size. The credit goes to surface-mount components supplied by Texas Instruments.

From the beginning, Siemens engineers knew that SMCs were the key to increasing board density while holding the line on size. The new Megafile drive accommodates seven disks instead of five — a 310-megabyte capacity versus 220 for previous models.

Siemens turned to TI not only because of a long working partnership but also because TI, through its pioneering SMT efforts, already had many of the needed functions in surface-mount packages. Supplies were immediately available, with demonstrated quality and reliability. And what was not available in SMT carriers was rapidly and precisely developed according to Siemens' specifications. Changes at short notice, working prototypes, and trial production runs were all taken care of without a hitch.

Throughout the development cycle, Siemens relied on the technical support and design assistance only TI could furnish on the spot. "Just the way it should be" is how Siemens engineers describe the cooperation given them by TI on this project.

™IMPACT is a trademark of Texas Instruments Incorporated.

™Megafile is a trademark of Siemens Electric GmBH.

Even more new TI products since the last time you asked...

Texas Instruments continues to lead the industry with reliable, producible integrated circuits designed to satisfy your needs. Simplify solutions to your design problems. Improve your competitive edge in the marketplace. The 81 new ICs (*see table*) recently introduced by TI (six new products per week!) include:

- An industry-first video-systems controller — available only in a 68-lead plastic chip carrier.
- A new military version of TI's pace-setting multiport video RAM.
- Six new high-density single-in-line-package (SIP) memory modules.
- High-speed, low-power 128K and 256K CMOS EPROMs that are socket-compatible with NMOS devices.
- New families of 2K and 16K high-performance IMPACT PROMs.
- Advanced Schottky 16-bit parallel/serial barrel shifters.

Nine of these new TI products are offered in surface-mount packages. And TI's innovative SIP memory modules combine the board-density advantages of SMT with the convenience of through-hole or socket mounting.

TI Package Designations

D: 150-mil small-outline package
DW: 300-mil small-outline package
FD: Square leadless ceramic chip carrier, JEDEC dimensions
FG: Rectangular leadless ceramic chip carrier, JEDEC standard
FK: Square leadless ceramic chip carrier, JEDEC standard
FM: Rectangular plastic leaded chip carrier
FN: Square plastic leaded chip carrier
GB: Pin-grid array
J: Ceramic dual-in-line package
JD: Side-brazed ceramic dual-in-line package
N: Plastic dual-in-line package
NT: Plastic dual-in-line, 300-mil, 24-pin package

Part Number	Description	Pin Count	Package Designators
TMS34061	Video systems controller	68	FN
TMS7742	EPROM microcontroller	40	J
TMS41128B-15	128Kx1 DRAM	16	N
TMS4464-12, -15, -20	64Kx4 DRAM	18	N
TMS27C256-17, -20, -25, -30, -45	256K CMOS EPROMs	28	J
TMS27C128-15, -20, -25, -30, -45	128K CMOS EPROMs	28	J
TM4256FC1-12, -15, -20†	1Mx1 SIP memory module	22	*
TM4256EC4-12, -15, -20†	256Kx4 SIP memory module	22	*
TM4256FL8-12, -15, -20†	256Kx8 SIP memory module (leaded)	30	*
TM4256GU8-12, -15, -20†	256Kx8 SIP memory module (leadless, socketable, with presence detection)	30	*
TM4256EL9-12, -15, -20†	256Kx9 SIP memory module (leaded)	30	*
TM4256GU9-12, -15, -20†	256Kx9 SIP memory module (leadless, socketable, with presence detection)	30	*
TM4161EV4-15, -20	64Kx4 SIP Multiport Video RAM module (leaded)	31	*
TM4161EP5-15, -20	64Kx5 SIP Multiport Video RAM module (leaded)	35	*
TM4161GW4-15, -20	64Kx4 SIP Multiport Video RAM module (leadless, socketable)	30	*
TM4161GY4-15, -20	64Kx4 SIP Multiport Video RAM module (leaded)	30	*
TBP38SA030-25	256-bit, 32x8 standard PROM with open collectors	16	N
TBP38S10-25	1K, 256x4 high-speed IMPACT PROM with 3-state output	16	N
TBP34SA10-25	1K, 256x4 high-speed IMPACT PROM with open collectors	16	N, FN
TBP38S22-18, -25	2K, 256x8 standard IMPACT PROM with 3-state output	20	N
TBP38SA22-30	2K, 256x8 standard IMPACT PROM with open collectors	20	N
TBP38L165-35, -45	16K, 2Kx8 low-power IMPACT PROM with 3-state output	24	NT
TBP38S165-25, -35	16K, 2Kx8 high-speed IMPACT PROM with 3-state output	24	NT
TBP38R165-18, -20	16K, 2Kx8 registered-output IMPACT PROM	24	NT
TBP34S162-25, -35, -45	16K, 4Kx4 standard IMPACT PROM with 3-state output	20	N
TIBPALR19L8C	Octal 19-registered-input AND-OR invert gate array	24	NT
TIBPALR19R8C	Octal 19-registered-input registered AND-OR gate array	24	NT
TIBPALR19R6C	Hex 19-registered-input registered AND-OR gate array	24	NT
TIBPALR19R4C	Quad 19-registered-input registered AND-OR gate array	24	NT
TIBPALT19L8C	Octal 19-latched-input AND-OR invert gate array	24	NT
TIBPALT19R8C	Octal 19-latched-input registered AND-OR gate array	24	NT
TIBPALT19R6C	Hex 19-latched-input registered AND-OR gate array	24	NT
TIBPALT19R4C	Quad 19-latched-input registered AND-OR gate array	24	NT
SN74HC132	HCMOS Schmitt-triggered NAND gates	14	D, N
SN74HC7001	HCMOS quad AND gates with Schmitts	14	D, N
SN74HC7002	HCMOS quad NOR gates with Schmitts	14	D, N
SN74HC7032	HCMOS quad OR gates with Schmitts	14	D, N
SN74ALS157	Quad 1 of 2 data selectors/multiplexers (true)	16	N
SN74ALS158	Quad 1 of 2 data selectors/multiplexers (invert)	16	N
SN74ALS231	Octal buffers and line drivers with complement G,G inputs	20	DW, FN, N
SN74ALS617	16-bit EDAC with open collectors	40	JD
SN74ALS633	32-bit EDAC with o.c. and pass-through capability	52	JD
SN74ALS634	32-bit EDAC with 3-state check-bit and data output	48	JD
SN74ALS841	10-bit bus-interface D-type latches with 3-state output	24	DW, FN, NT
SN74AS897	16-bit parallel/serial barrel shifters	68	GB
SN74AS1181	Enhanced 4-bit arithmetic logic unit	24	DW, FN, NT
SMJ4161-15	Military Multiport Video RAM	20	JD
SMJ4256-15	Military 256K DRAM	16	JD
JANB54ALS175 JM38510/37202BEA	Military quad D-type flip-flop	16	J

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PP27 ☐ Video Systems Controller Product Description
PN01 ☐ Eight-Bit Microcontroller Information Packet
MY01 ☐ DRAM Information Packet
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CALENDAR

CIMTECH '86, Boston, MA. Society of Manufacturing Engineers, Box 930, Dearborn, MI 48121. (313) 271-1500. March 10 to 13.

Integrated Services Digital Networks Exposition, Dallas, TX. Information Gatekeepers, 214 Harvard Ave, Boston, MA 02134. (617) 232-3111. March 10 to 14.

Structured 8086/186 Assembler (short course), Madison, WI. Donna Miller, Micro-Managers, 1435 E Main St, Madison, WI 53703. (608) 251-6661. March 10 to 14.

Automated Design and Engineering for Electronics (ADEE) West, Moscone Convention Center, San Francisco, CA. Cahners Exposition Group, Box 5080, Des Plaines, IL 60018. (312) 299-9311. March 11 to 13.

Southcon, Orlando, FL. Electronic Conventions Management, 8110 Airport Blvd, Los Angeles, CA 90045. (213) 772-2965. March 11 to 13.

Physical Design '86 Conference, Houston, TX. Susie Whitesell, PD '86, 10401 Weller St, Austin, TX 78750. (512) 331-1303. March 12 to 14.

Personal Computers in Industry (symposium), San Diego, CA. ICS, 8601 Aero Dr, San Diego, CA 92123. (619) 279-5726. March 17 to 18.

Correlation and Spectral Analysis (short course), Monterey, CA. Continuing Education Institute, 10889 Wilshire Blvd, Los Angeles, CA 90024. (213) 824-9545. March 17 to 20.

IEEE Work Station Technology and Systems Conference, Atlantic City, NJ. Helen Yonan, IEEE Office, Moore School, University of Pennsylvania, Philadelphia, PA 19104. (215) 898-8134. March 17 to 20.

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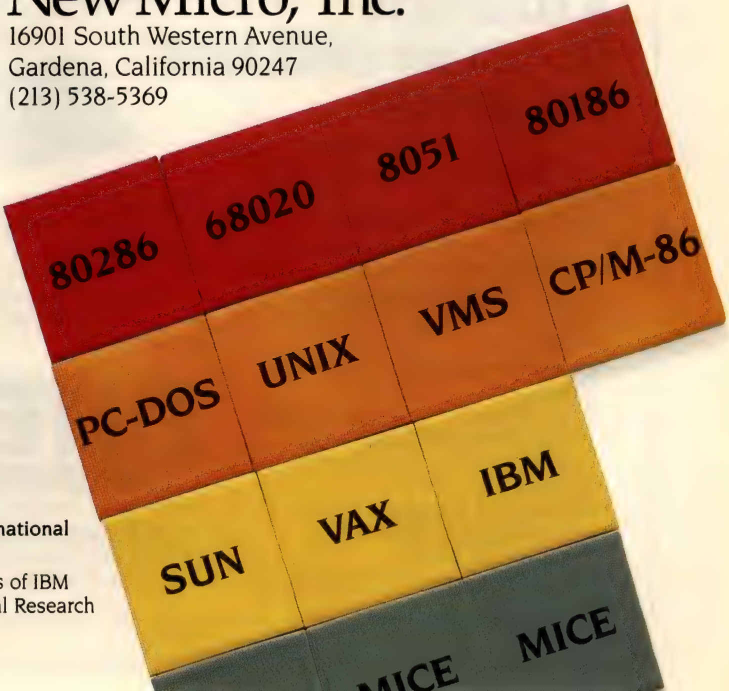

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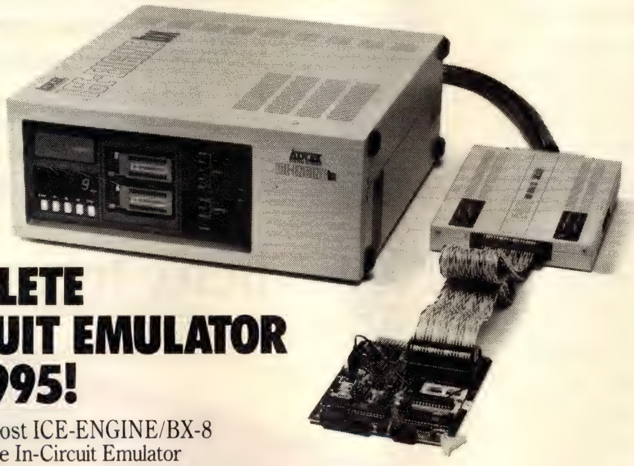

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CALENDAR

Measurement Systems Dynamics (short course), Phoenix, AZ. Peter Stein, Measurement Systems, 5602 E Monte Rosa, Phoenix, AZ 85018. (602) 945-4603. March 17 to 21.

Test Data Acquisition and Processing for Instrumentation Applications (short course), Milwaukee, WI. John Snedeker, Center for Continuing Engineering Education, University of Wisconsin-Milwaukee, 929 N 6th St, Milwaukee, WI 53203. (414) 224-4193. March 17 to 21.

IEEE VLSI Test Workshop, Atlantic City, NJ. Wesley Radcliffe, IBM East Fishkill, Dept 227, Bldg 321-5E1, Hopewell Junction, NY 12533. (914) 894-4346. March 18 to 19.

Consulting Engineers Expo and Conference, Chicago, IL. American Consulting Engineers Council, 1015 15th St NW, Washington, DC 20005. (202) 347-7474. March 18 to 20.

Grounding and Shielding (short course), San Diego, CA. Interference Control Technologies, Box D, Gainesville, VA 22065. (703) 347-0030. March 18 to 21.

Personal Computer Interfacing for Scientific Instrument Automation, Blacksburg, VA. Linda Leffel, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. (703) 961-4848. March 19 to 21.

Modern Electronic Packaging (seminar), Raleigh Marriott Hotel, Raleigh, NC. Technology Seminars Inc, Box 487, Lutherville, MD 21093. (301) 269-4102. March 19 to 21.

OAC '86 (Office Automation Conference), Houston, TX. AFIPS, 1899 Preston White Dr, Reston, VA 22091. (800) 623-1986. March 24 to 26.

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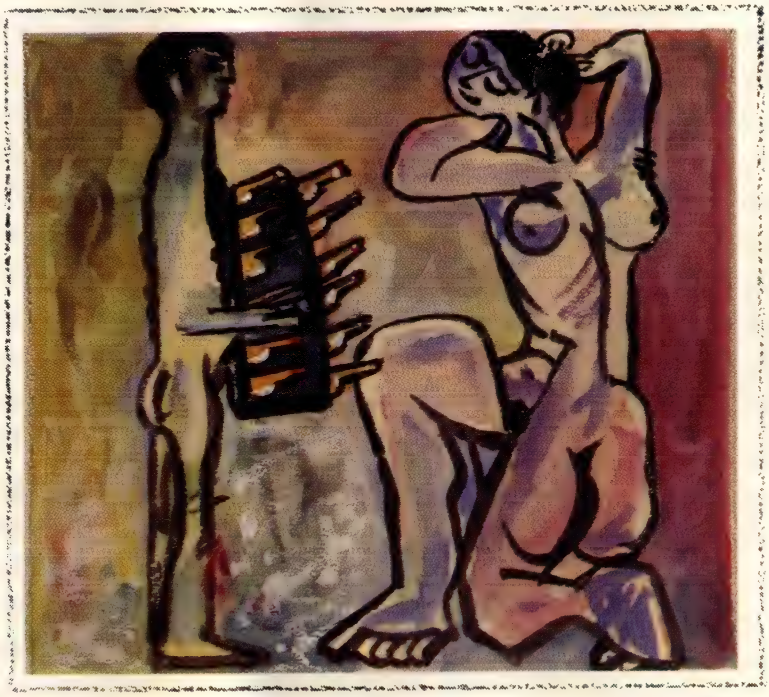

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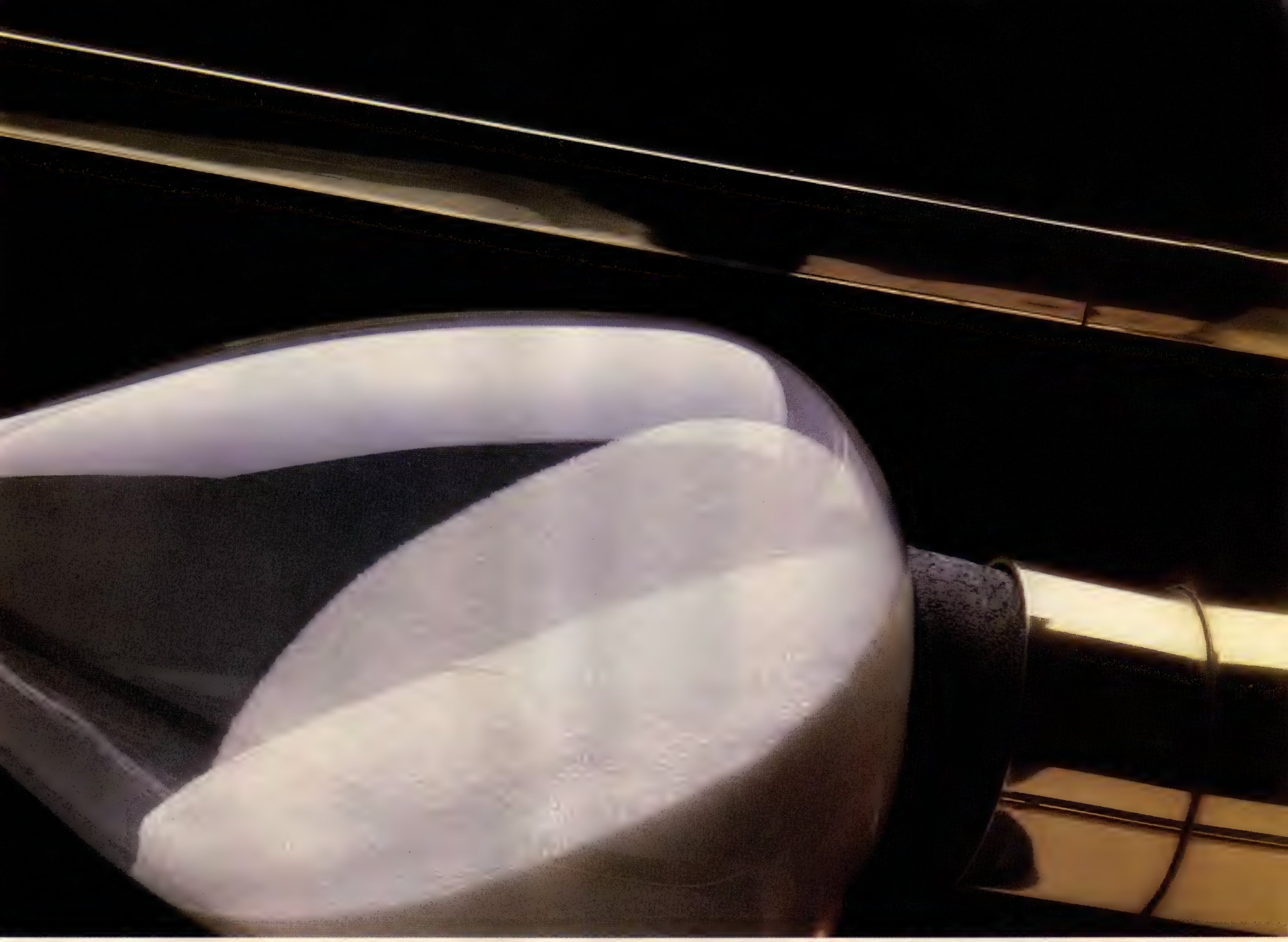

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HMD-11113-2	Dual 2-Input Exclusive OR	2.0 GHz	2.8 GHz	400 ps
HMD-11131-2	Master/Slave D Flip-Flop	2.0 GHz	3.0 GHz	500 ps
HMD-11301-2	Divide by Two/Prescaler	2.2 GHz	3.0 GHz	375 ps
HMD-11502-2	Programmable Pulse Driver/Formatter	1.0 GHz	1.2 GHz	900 ps
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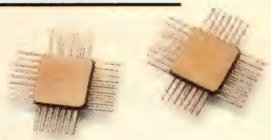

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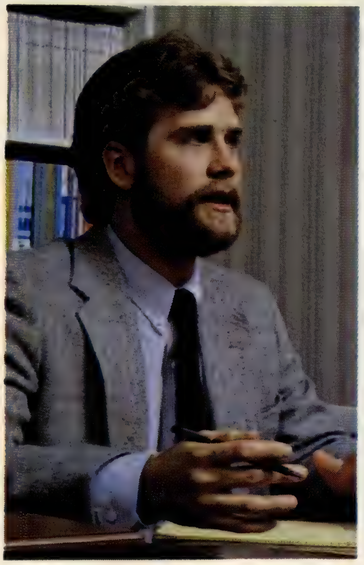
CIRCLE NO 41

Semicustom ICs—The next dynamic-RAM market?



Japanese electronics firms have stormed the US semicustom-IC market. They offer advanced products, and they are increasing their customer support through design centers and workstation software. These companies have the combination of economical production and long-term strategy that could drive down semicustom-IC prices just as it pushed dynamic-RAM prices down. To survive Japanese encroachment, US semicustom-IC vendors must exploit the distinguishing characteristic of semicustom ICs—customer involvement in product design—and they must act now.

Japanese companies target the semicustom-IC market because, although these ICs are quite different from dynamic RAMs, they are just as significant to the electronics industry. Dynamic RAMs are the driving force in the development of processing technologies; in a similar fashion, semicustom ICs are the driving force for IC-design technologies such as CAE. Being established in the dynamic-RAM market creates opportunities in other computer-chip markets such as memory-IC controllers; semicustom-IC technology opens the door to lucrative specialty markets, such as medical and industrial electronics. Furthermore, semicustom ICs themselves are becoming big business: Some estimate they will account for 22% of all IC sales in 1990.

Japanese companies already demonstrate the ability to lead the semicustom-IC market. The largest channeled arrays come from NEC and Fujitsu; Toshiba produces the largest channelless arrays (admittedly, in cooperation with the US firm LSI Logic). For customer support, Japanese companies are opening design centers and making macrocell libraries available for workstations from Daisy, Mentor, and Valid. They are also taking advantage of other conduits to the engineering community. Hitachi, for example, sells its gate arrays through the American distributer Diplomat Electronics.

Having conceded the memory market to the Japanese, US companies cannot afford to let the Japanese dominate the semicustom-IC market and design technology. They must reach out and capture the marketplace's interest, taking advantage of their inherent proximity to the potential market for semicustom-IC services. Such efforts are beginning; for example, Gould/AMI offers free seminars in the use and benefits of semicustom ICs. But more effort is necessary. Vendors must make available widespread training sessions, clearly documented examples of successful semicustom-IC projects, and detailed cost/benefit analyses.

Most important, considering the nature of Japanese competition, US companies must reduce their design charges and turnaround times. A sacrifice of profit margin is required now to establish a customer base that is familiar with and confident of a company's products and design services. Other, more innovative approaches, such as LSI Logic's Composable Arrays, can augment US competitiveness by allowing customers to define the semicustom products they need without incurring the full risk and cost of custom-IC development.

A combination of increased knowledge and awareness, lower cost, and close cooperation between customers and manufacturers is vital to the survival of US vendors of semicustom ICs. Surviving the competition of Japanese companies will not be easy; the time to compete is now.

David Smith

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Associate Editor

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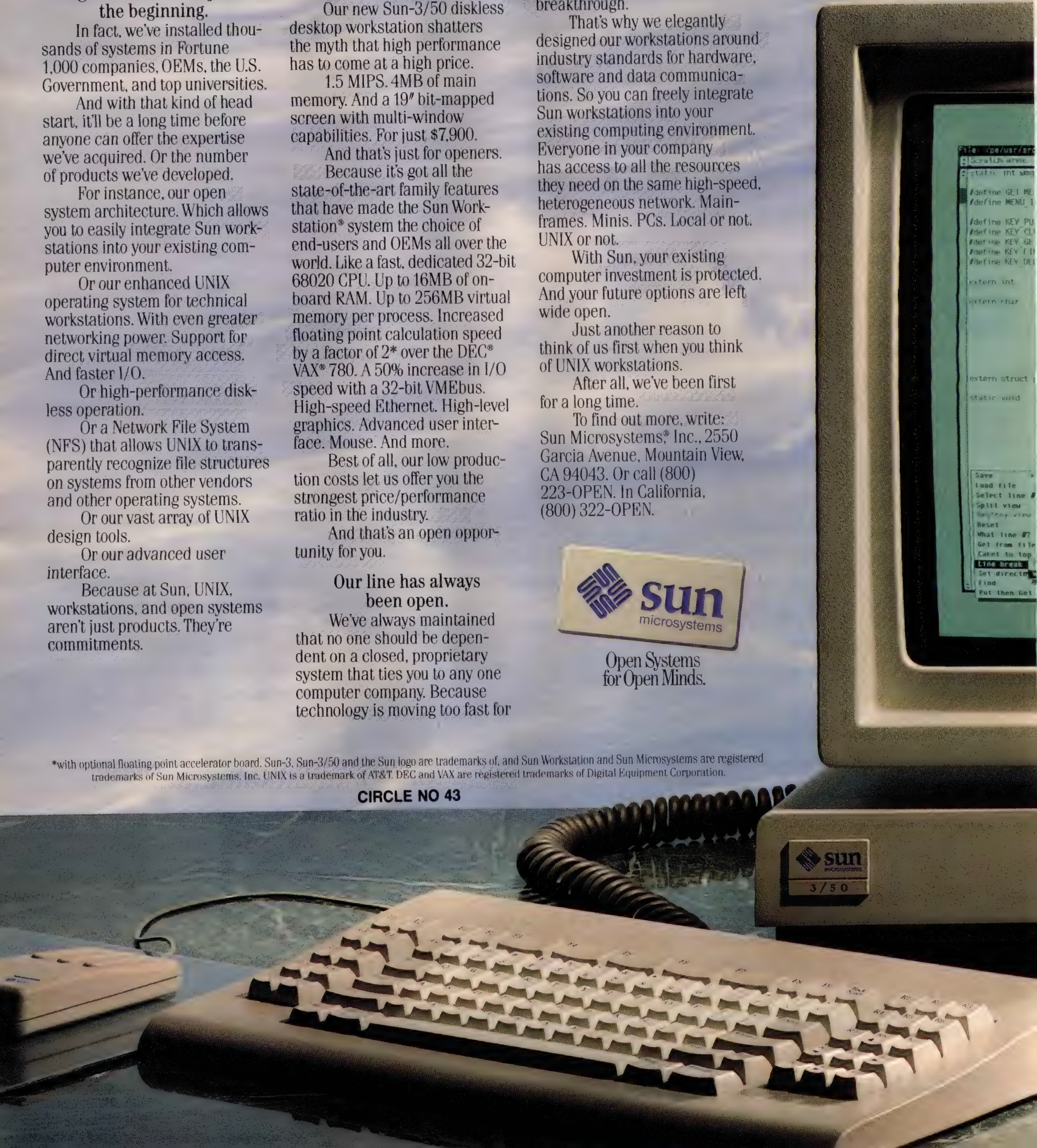

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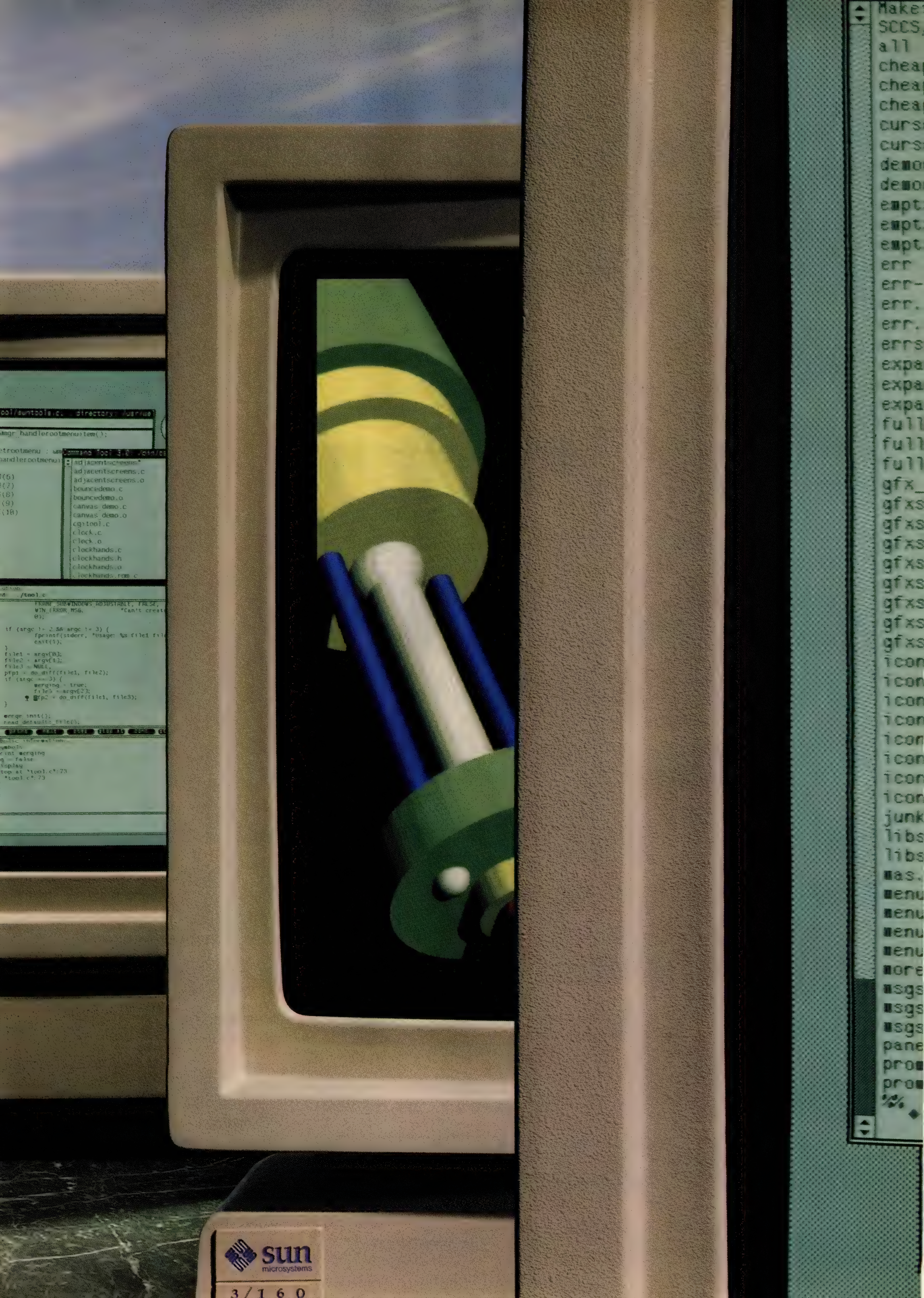

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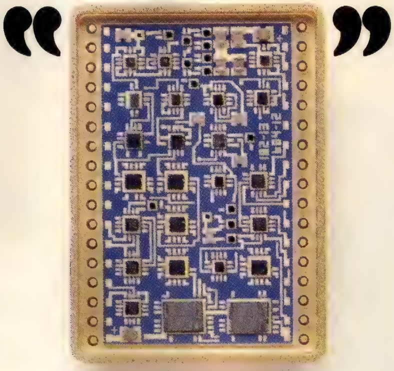

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CIRCLE NO 44

Gallium arsenide monolithic linear ICs gain in affordability and availability

Bill Travis, *Senior Editor*

At the point of overcoming their traditional image as expensive laboratory curiosities, GaAs-processed linear ICs are becoming more available and more affordable. Once available only in custom form (usually to military contractors, at very high prices), the ICs now also take the form of catalog items from several newly formed and established manufacturers.

By far the largest users of GaAs linear ICs, defense-system manufacturers use the amplifiers in EW, C^{3}I, radar, and other systems that operate at extremely high frequencies and require high radiation tolerance. As production ramps up and prices come down, though, the GaAs circuits promise to find increasing use in telecommunications, instrumentation, data-processing, and even consumer applications.

Direct-coupled gain block

Most MMICs (monolithic microwave ICs) on the market incorporate capacitive coupling between their internal stages; their specs, therefore, state low- as well as high-frequency cutoffs: 50 MHz to 3 GHz, for example. Not so with the ADA25001 from Anadigics Inc, a start-up company whose sole mandate is to produce GaAs linear ICs.

The ADA25001 uses direct coupling throughout and offers a 22-dB min voltage gain; a 0- to 2.3-GHz min, 3-dB frequency response **(Fig 1)**; and a 5.5-dB max noise figure. Such a dc-coupled, high-frequency amplifier suits use in the front end of a fiber-optic receiver/repeater link **(Fig 2)**. The GaAs IC amplifies light pulses detected by the avalanche photodetector or pin diode.

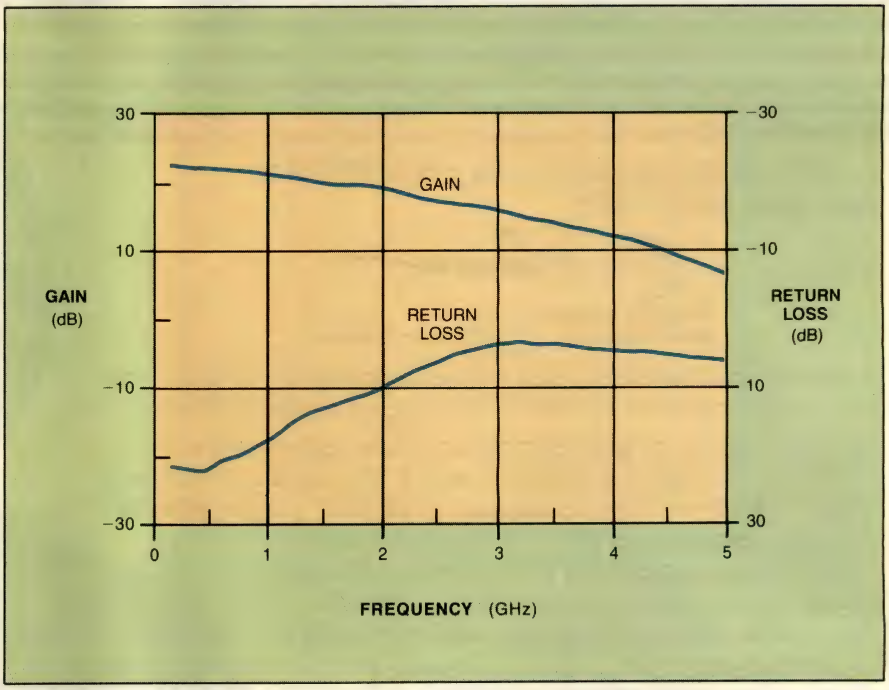

Fig 1—Providing useful voltage gain at frequencies beyond 4 GHz, *the ADA25001 from Anadigics is a dc-coupled MMIC amplifier whose frequency performance is far beyond the capabilities of silicon-based ICs.*

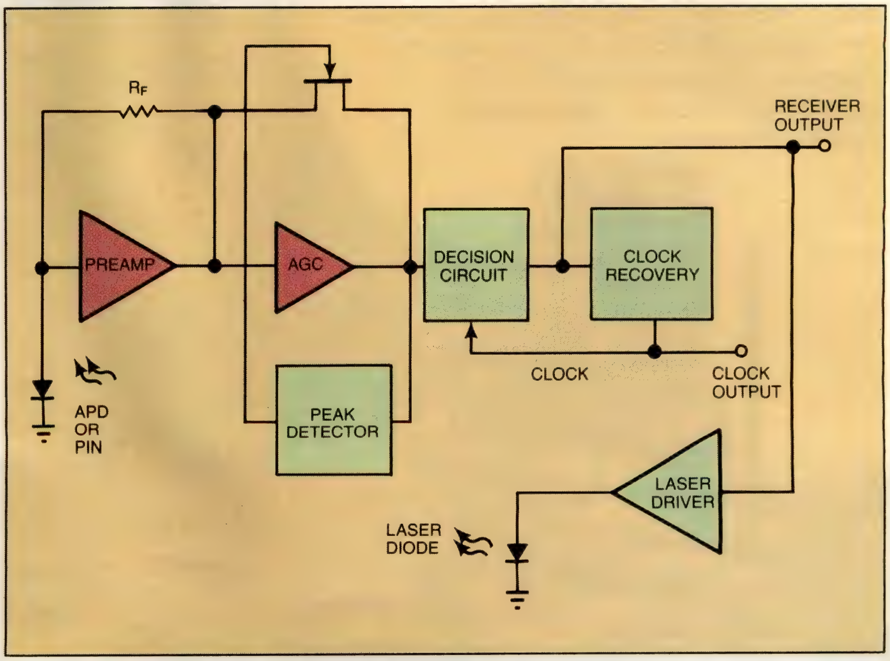

Fig 2—A typical application for GaAs-processed amplifiers, *this fiber-optic repeater/receiver uses GaAs MMICs in the preamplifier and AGC-amplifier sections. As various GaAs ICs become available, they'll assume the roles of the remaining circuit blocks in the link.*

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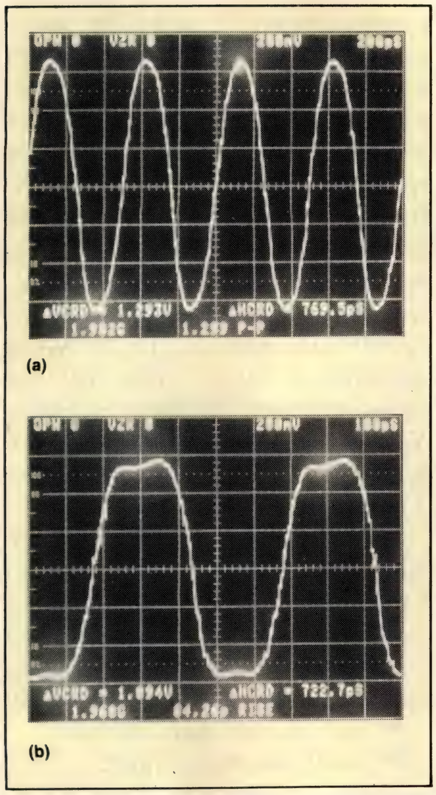


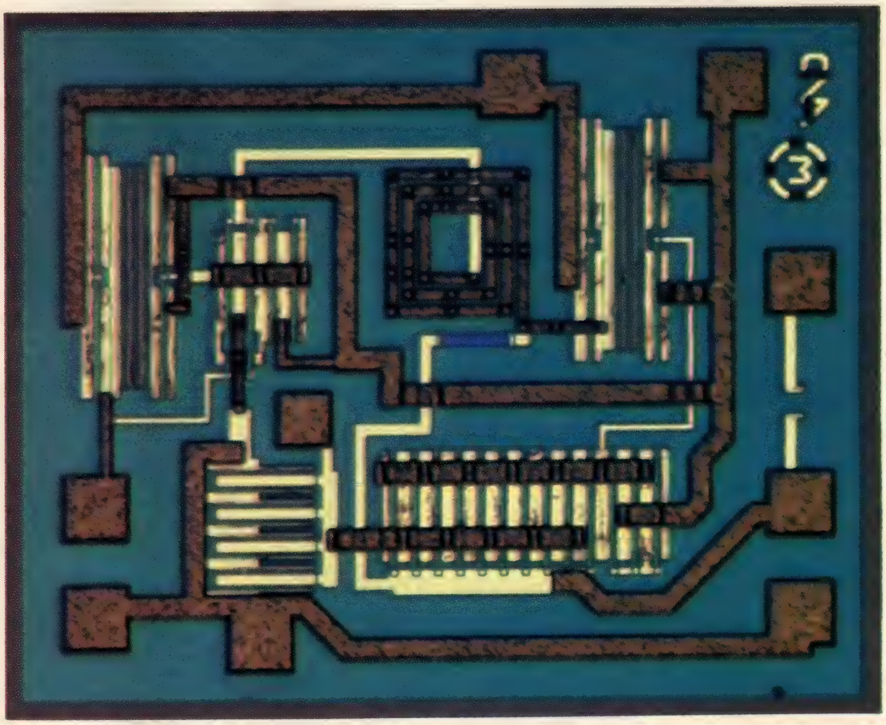
Fig 3—The ADA25001 handles sine waves *and pulses with ease. In* ***a****, the amplifier provides a 1.3V p-p sinusoidal output at 2 GHz; in* ***b****, the IC serves as a clipping amplifier that yields a 1.2V p-p pulse train.*

The succeeding amplification stage has automatic gain control that controls the level of signals applied to the decision circuit, which supplies the receiver output (and the input to the laser-diode driver) in NRZ (nonreturn-to-zero) form.

Fig 3a shows the ADA25001's sine-wave response. At 2 GHz, a −14-dBm input drive produces 1.3V output in a 50Ω load. The waveform in **Fig 3b** is the output of an ADA25001 configured as a clipping amplifier. An 8-dBm input sine wave produces 100-psec clock edges. Driven in this mode, the IC can operate as a 4G-bps NRZ data amplifier.

Note that the results shown in **Fig 3** are those obtained after mounting the ADA25001 in chip form on an alumina substrate, using microwave stripline and ground-plane techniques for all connections to the IC. The stray inductance and capacitance of available IC packages inevitably exact a toll in high-frequency performance. For example, the IC provides adequate performance to approximately 1.5 GHz in a miniature leadless chip carrier and to about 800 MHz in a DIP.

Sole member—so far—of a projected family of linear GaAs ICs from Anadigics, the ADA25001 will gain two siblings in the first half of this year: a sample/hold amplifier and a comparator. The company's future plans include GaAs-processed A/D converters and more linear amplifiers. The ADA25001 costs $89 (1000); a $1500 evaluation kit includes 10 devices and a test fixture.

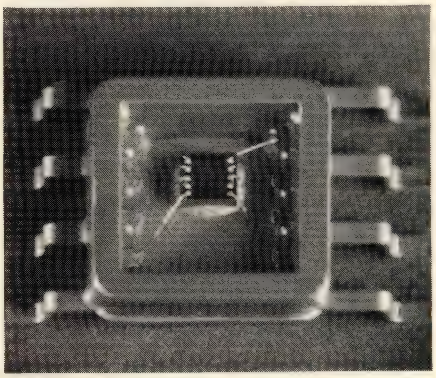


A rarity among multistage GaAs MMIC amplifiers, *the ADA25001 from Anadigics is dc coupled. The direct coupling makes the device useful in a variety of applications: for example, in fiber-optic transmission for data communications or telecommunications.*

GaAs MMIC has gain control

In many applications (for example, the repeater/receiver of **Fig 2**), automatic gain control (AGC) is required to maintain a constant signal level at a given point in the circuit. You could, of course, design your own AGC circuit, using some sort of envelope-detection circuitry in conjunction with a dc-voltage-controlled RF-diode attenuator, for example.

In the gigahertz world, however, where wiring often resembles plumbing and undesirable stray circuit elements lurk everywhere, an important rule of thumb applies: Less is better. The fewer components you can use to implement a function, the better the chances to obtain the desired performance.



A 1-chip GaAs RF/IF converter *from Pacific Monolithics needs only a detector and audio (or video) output to make a complete 3- to 6-GHz receiver. The PM-C1003 is well suited for satellite communications.*

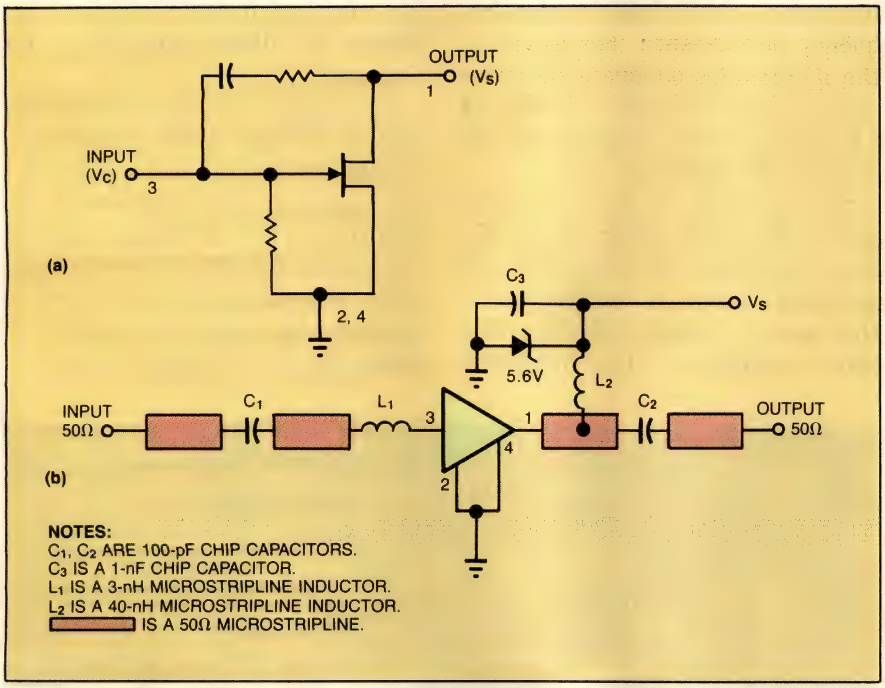

OUTPUT
(Vs)
1
INPUT
(Vc)
3
(a)
2, 4
C3
Vs
5.6V
L2
INPUT
50Ω
C1
L1
3
1
4
2
C2
OUTPUT
50Ω
(b)
NOTES:
C1, C2 ARE 100-pF CHIP CAPACITORS.
C3 IS A 1-nF CHIP CAPACITOR.
L1 IS A 3-nH MICROSTRIPLINE INDUCTOR.
L2 IS A 40-nH MICROSTRIPLINE INDUCTOR.
▭ IS A 50Ω MICROSTRIPLINE.

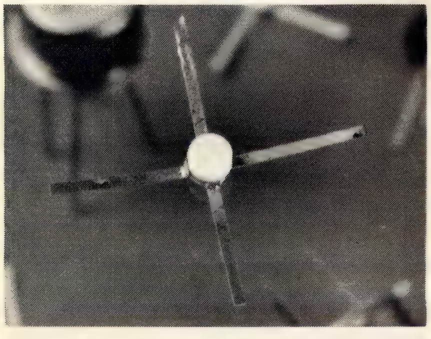
*Fig 4—**A single-stage GaAs broadband amplifier,** the CGY40 **(a)** from Microwave Semiconductor Corp, incorporates a GaAs FET and three passive components. You must use stripline techniques to effect input and output connections **(b)** to the device.*

A recent GaAs broadband amplifier from Microwave Semiconductor Corp (a Siemens company) provides a simple means of controlling gain. Model CGY40 **(Fig 4a)** is a 1-stage MMIC amplifier that provides 8-dB min power gain at "low" frequencies (hundreds of megahertz) and more than 4-dB gain to frequencies as high as 4 GHz. **Fig 4b** shows a typical connection diagram for the CGY40.

Fig 5a depicts a typical frequency-response curve for the CGY40. Note that power gain is typically greater than 5 dB at 4 GHz. Gain-control characteristics are shown in **Fig 5b.** The abscissa, V_C, is the dc control voltage applied to the MMIC's input. **Fig 5c** shows the result of applying even more negative dc voltages to the input. Be aware that the noise figure increases as V_C becomes more negative. **Fig 5d** shows the noise figure at 800 MHz and 1.8 GHz for V_C as negative as −0.8V; note that the noise increases for more negative V_C and that the 4-GHz noise figure is about 1 to 1.5 dB greater than the 1.8-GHz figure.

Designed for surface-mount applications, the $7.99 (OEM qty) CGY40 MMIC amplifier comes in a miniature ceramic package dubbed "cerec" (ceramic economic) by its manufacturer. Salient specs include

- ±2-dB max gain flatness
- 4-dB max noise figure



A surface-mountable GaAs MMIC amplifier, *the CGY40 single-stage device from Microwave Semiconductor Corp provides the flexibility of dc gain control. This feature makes it easy to configure amplifiers that need AGC capabilities.*

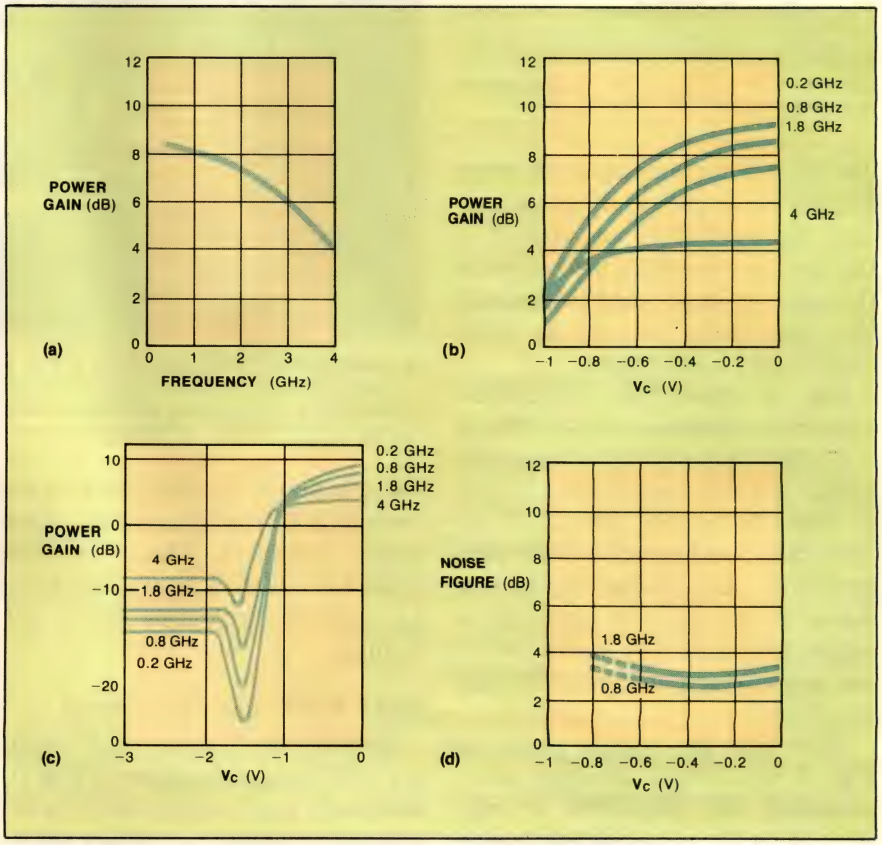


*Fig 5—**Useful in applications requiring AGC,** the CGY40 offers better than 5 dB of power gain at 4 GHz **(a)** and provides a wide range of gain control. By varying the dc input voltage **(b)**, you can obtain about 7 to 8 dB of gain control. More negative voltages **(c)** produce even greater variations in gain. Note, however, that noise level increases with more negative control voltages **(d)**.*

The Latest Word in Gate Arrays:

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mi·cro·tach·y·a·no·rex·i·lo·go·prax·is \ˈmīkrō ˈtakē anō ˈreksē ˈlōgō ˈpraksəs \ ***n*** [*G micro-* small + *-tachy-* fast + *-anorexi-* not hungry + *-logo-* logic + *-praxis-* function] : term coined by Raytheon to describe a dense VLSI, high speed, low power gate array family

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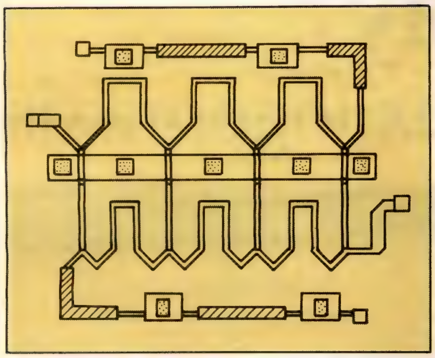

*Fig 6—**A distributed amplifier for the 2- to 12-GHz range,** an MMIC from Microwave Semiconductor Corp uses internal transmission lines between cascaded GaAs FETs. The manufacturer estimates that the cascade approach makes the production of 40-GHz GaAs MMICs feasible.*

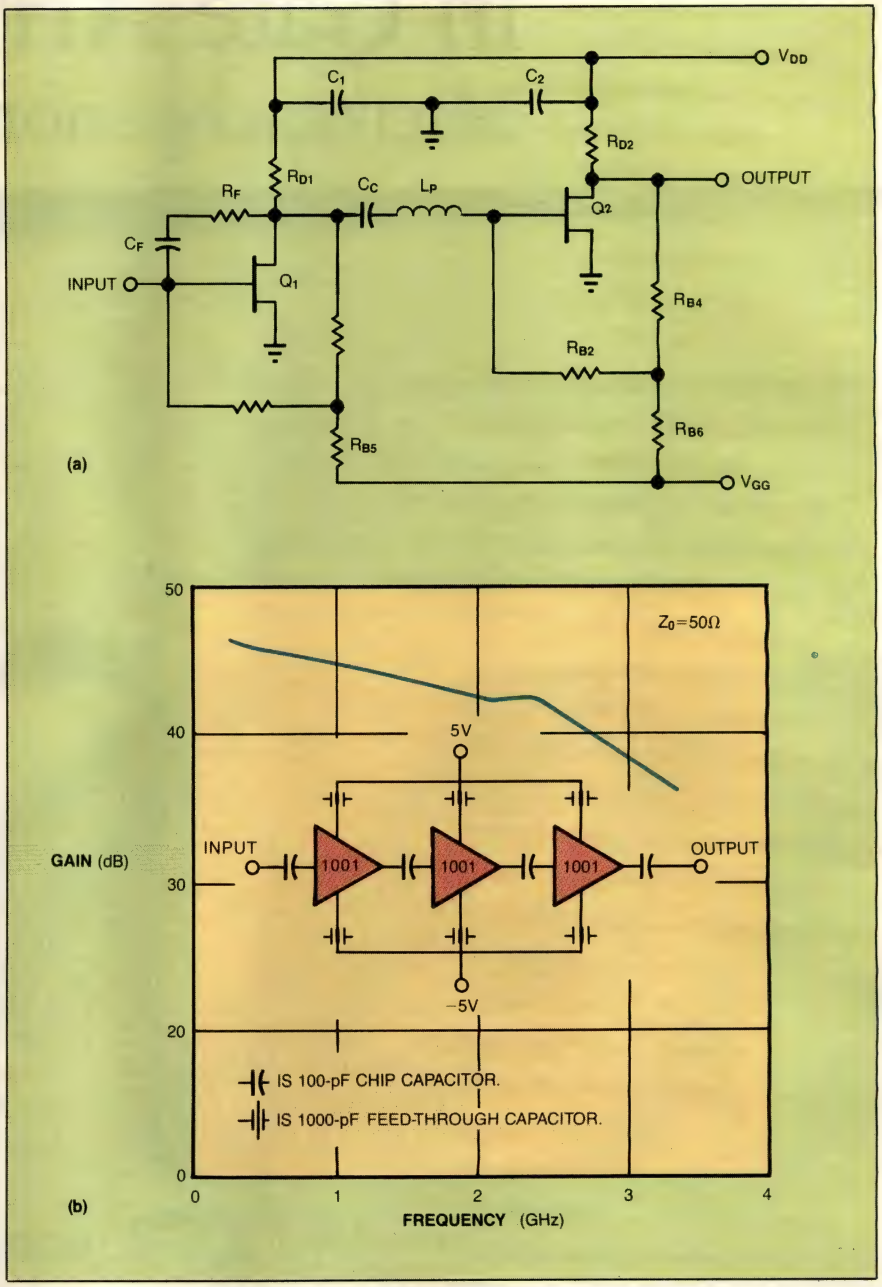

*Fig 7—**Precise input and output matching** makes it easy to cascade NEC's NEPA1001 GaAs MMIC amplifiers **(a)**. The plot in **b** shows the result of cascading three devices. The cascaded units provide 30-dB gain to approximately 4 GHz.*

- 2:1 max VSWR (input and output)
- 17-dBm typ output at 1-dB compression
- 3-GHz typ 3-dB bandwidth
- 3 to 5.5V operating voltage.

One way to obtain an extremely broadband amplifier response is to cascade several FET stages on one chip. A distributed-amplifier MMIC from Microwave Semiconductor Corp, planned for release in mid-1986, uses such a cascade approach. **Fig 6** shows a sketch of the chip's layout. The die measures 2.7×2.1×0.1 mm. In this configuration, the input and output capacitance of the FETs combine with inductors to form lumped-element artificial transmission lines. The transconductance of the active devices provides coupling for the transmission lines. Preliminary characteristics of the broadband MMIC include

- 2- to 12-GHz bandwidth (40 GHz feasible)
- 8.5±0.5-dB gain
- 20-dBm output power
- 4- to 5-dB noise figure
- 1.5 VSWR
- four FET cells
- 300-μm gate width per cell
- 1-μm gate length.

High-gain applications invariably entail a cascade connection of more than one gain stage. At the high operating frequencies of GaAs MMICs, stage-to-stage impedance matching is crucial: Any mismatch results in reflections that completely distort the amplifier's frequency-response characteristics. A GaAs MMIC amplifier from NEC (marketed in the US by California Eastern Laboratories Inc) provides precise 50Ω input/output matching.

Model NEPA1001 **(Fig 7a)** is an ac-coupled, 2-stage amplifier that provides 12-dB min gain over 0.1 to 2 GHz and 10 dB min over 2 to 3 GHz. The IC's input return loss is 6 dB min from 0.1 to 1 GHz and 2 to 3 GHz and 10 dB min over 1 to 2 GHz. Output return loss is 10 dB min over the entire 0.1- to 3-GHz range. The device specs ±1-dB gain flatness from 0.1 to 2 GHz and ±1.5 dB from 2 to 3 GHz.

Fig 7b shows the simple cascade connection of three NEPA1001s as well as the resulting gain-vs-fre-

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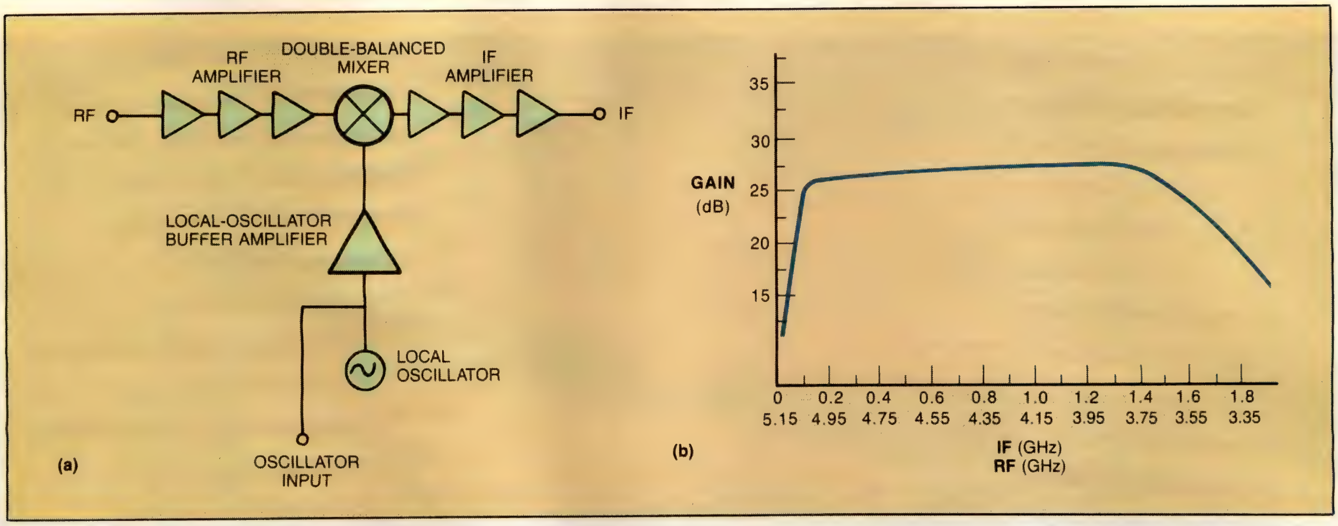

Fig 8—Half of a radio receiver on a GaAs chip, *the PM-C1003 subsystem* ***(a)*** *from Pacific Monolithics combines RF and IF amplifiers, a local oscillator, and a mixer. The plot in* ***b*** *shows the MMIC's RF-to-IF conversion characteristics. Different versions of the device are available to accommodate frequency ranges other than the PM-C1003's 3 to 6 GHz.*

quency plot. The 3-stage circuit maintains 40-dB gain to almost 3 GHz. The MMIC operates from ±5V supplies and draws 80 and 5 mA max, respectively, from the supplies. Noise figure is 4.5 dB max from 0.1 to 2 GHz and 5 dB max from 2 to 3 GHz.

You can obtain the NEPA1001 in a choice of two package types: The AA (TO-72) package is a 200-mil-diameter metal can, and the FA housing is a square flat pack that measures 180 mils on a side. Note that the NEPA1001, as well as all the MMICs described here, is a static-sensitive device; in handling the ICs, you must take precautions (eg, a ground strap) against electrostatic discharge.

All the MMICs described thus far have one role: to provide amplification. Inasmuch as the ICs integrate various passive and active devices on one chip, they deserve the appellation "integrated circuit." The next logical step in integration is to integrate diverse functions, or circuit blocks, on a given chip. You can find such high-level integration in the Model PM-C1003 converter subsystem from Pacific Monolithics.

A complete front end for a 3- to 6-GHz receiver, the PM-C1003 (**Fig 8a**) incorporates an RF amplifier, a local oscillator, a mixer, and an IF amplifier. The RF input accepts signals whose frequencies range from 3 to 6 GHz, and the local oscillator operates over 4.5 to 5.5 GHz. You could, alternatively, use an external oscillator to drive the mixer. The output from the IF amplifier covers the range 50 MHz to 2 GHz.

Conversion gain for the subsystem is 35 dB typ, and noise figure is 4.5 dB typ. VSWR at the RF and IF ports is 2.5:1. Local-oscillator leakage from the oscillator to the RF line is −28 dB typ; leakage from the oscillator to the IF output is −25 dB typ. Output power at the 1-dB compression point is 0 dBm. **Fig 8b** shows a plot of the MMIC's IF-gain vs RF-input response.

A notable feature of the PM-C1003 is its price—less than $20 in production quantities. Such pricing belies the image of GaAs MMICs as unaffordable, reserved-for-the-military laboratory curiosities. Three packaging options are available for the PM-C1003. The device comes in chip form (40 mils square), in a 175-mil-square flat pack, or in a metal case that provides RF and IF coaxial connectors. The subsystem draws 160 and 10 mA, respectively, from ±5V supplies. The manufacturer also offers other versions of the subsystem for the RF-input ranges of 1.5 to 2 and 5.5 to 7.5 GHz. **EDN**

For more information . . .

For more information on the GaAs monolithic microwave ICs described in this article, circle the appropriate numbers on the Information Retrieval Service card or contact the following manufacturers directly.

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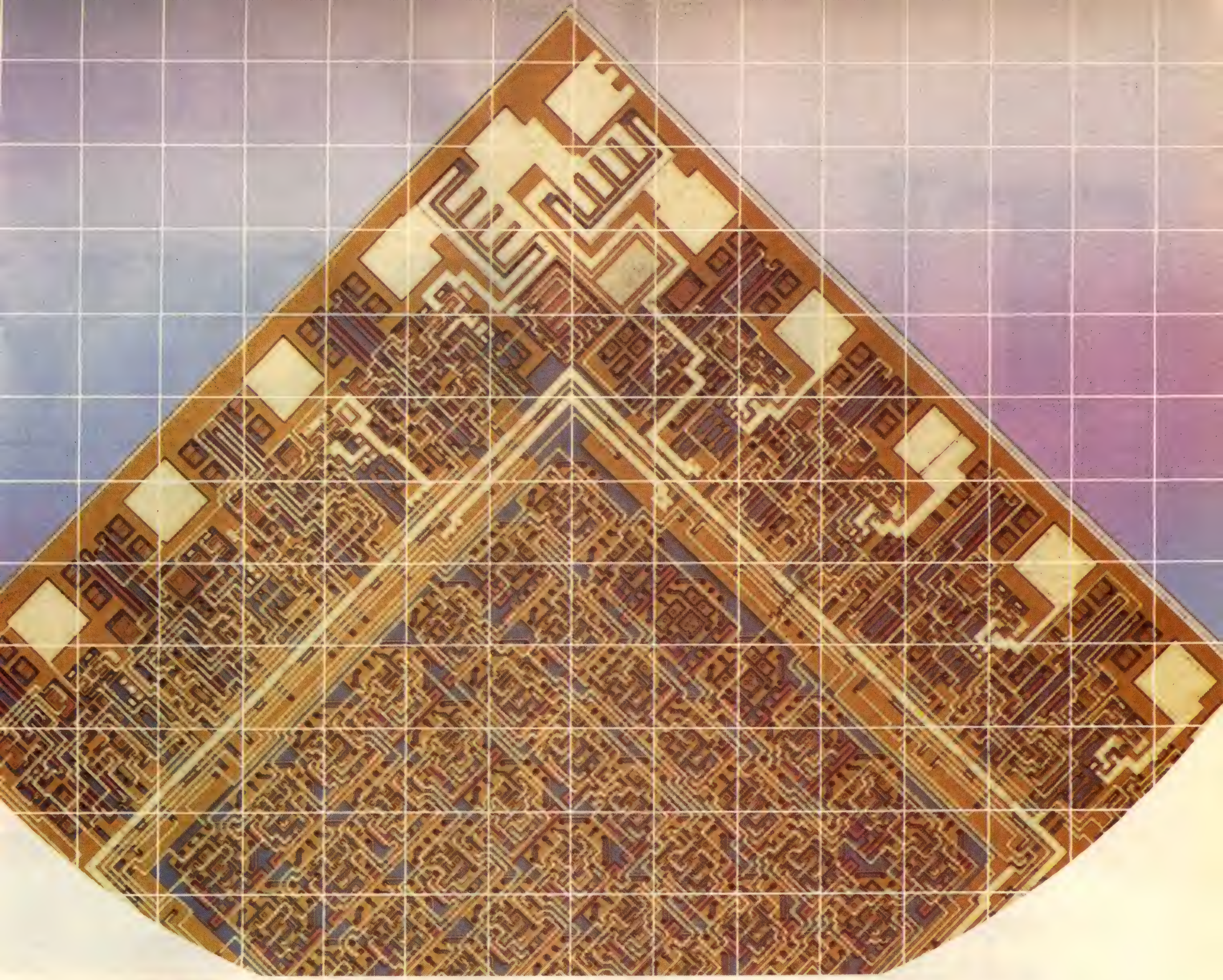

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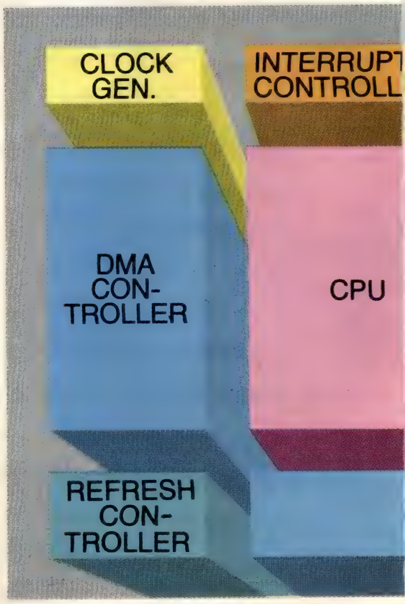
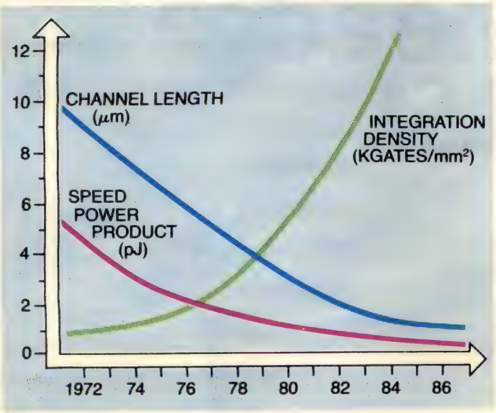
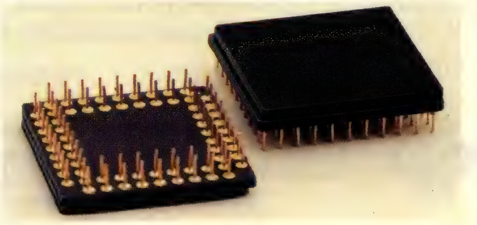


V40/V50 – System performance integrated on chip. The new NEC V40 and V50 microprocessors offer full 16-bit CPU performance combined with on-chip peripheral functions. Designed to meet the demands of a wide range of applications, these large-scale integrated CMOS devices can operate at 8 and 10 MHz and feature 3 programmable 16-bit timers, a programmable interrupt controller, a serial interface, an on-chip clock generator and 4 DMA channels. 1 Mbyte address space plus 64 Kbyte I/O space can handle all system requirements. For applications with heavy computational loads the V40/V50 microprocessors can be coupled to a floating point processor.



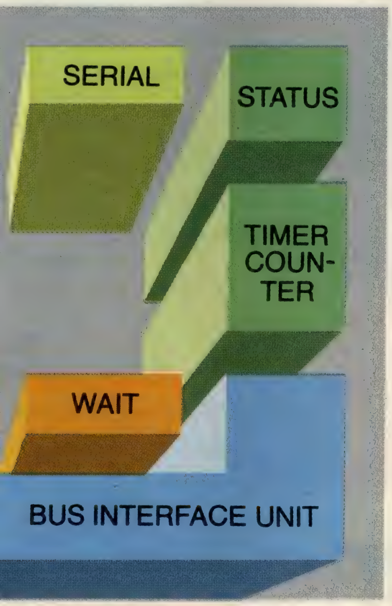
NEC is firmly committed to CMOS technology. This technology packs more than 90.000 transistors on a single chip to provide the power, speed and reliability demanded of modern LSI devices. The low power consumption allows flexibility in device packaging.

NEC microprocessors safeguard hardware and software investments. The V40/V50 microprocessors provide compatible path for software developed on V20/V30* machines. The on-chip peripherals are either fully compatible or a subset of standard peripherals



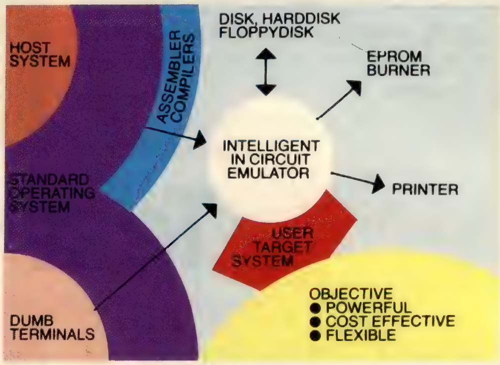
the field
V-Series.

V40/V50
16-BIT
MICROPROCESSORS



for easy adaptation of existing systems. I/O addresses are programmable, allowing programs tied to particular hardware configuration to run without modification. Cascadable DMA and interrupt controllers guarantee system expandibility.

Full and flexible development support. NEC has designed powerful development tools such as the in-circuit emulator with integrated floppy drives, and a monitor allowing on line symbolic debugging, assembly and disassembly. The in-circuit emulator can be connected to industry-standard hosts using standard operating systems such as MP/M-86**, CP/M-86** or MS-DOS**.



The 32-bit future. The V60/V7X super-micros with up to 700.000 transistors on-chip are already in an advanced stage of development.

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*V20/V30 NEC's 16-bit CMOS microprocessors have an instruction set which is a super set of the µPD 8088/8086 microprocessors.

**MP/M-86, CP/M-86 are registered trademarks of Digital Research Corp. MS-DOS is a registered trademark of Microsoft Corp.

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CIRCLE NO 50

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CIRCLE NO 51

Filter connectors offer a cost-effective solution to EMI/RFI problems

Tom Ormond, *Senior Editor*

Since 1984, FCC regulations (Docket 20780) have required commercial- and industrial-equipment designers to incorporate EMI/RFI shielding in their electronic systems. Some methods of providing this protection, such as shielding cables, can make a system more expensive to design or even degrade the system's performance. Filter connectors, however, can protect a system from EMI/RFI characteristics without incurring great expense or significantly decreasing your system's performance.

Filter connectors, which have long been used in military applications, are now inexpensive enough to be suitable for commercial and industrial systems. Because they incorporate all the necessary filtering components in a single package, these connectors can save pc-board real estate and reduce pc-board trace requirements, thus reducing your overall system-design costs. In addition, because the filter elements reside inside the connector housings, the leads are shorter, so the connectors keep stray inductance to a minimum.

Typically, a computer's I/O lines transmit relatively low-frequency signals to various peripheral devices. Internal RF coupling can easily leak the clock signal's high-frequency harmonics onto the I/O line, causing EMI/RFI radiation problems. In a system that's using a 1-MHz clock, for example, harmonics can extend beyond 175 MHz. In a system operating with a 10-MHz clock signal (a typical frequency in many computers), the harmonic spectrum will extend even further than 175 MHz. However, you can use a lowpass filtering scheme—such as filter connectors—to attenuate the unwanted high-frequency harmonics while allowing the desired low-frequency logic signals to pass without much degradation.

To attenuate high-frequency signals without adversely affecting a system's operating frequencies, a

***You can provide EMP protection for sensitive components** in 5 to 240V dc circuits by using Bendix MOV (metal oxide varistor) connectors from Amphenol. The units are intermatable and intermountable with MIL-C-38999, -26482, -5015, and -27599 connectors.*

***Satisfying a variety of insertion-loss requirements,** AMP's Quiet Line connectors offer you a choice of capacitive (C) or distributed-element (π) filter configurations.*

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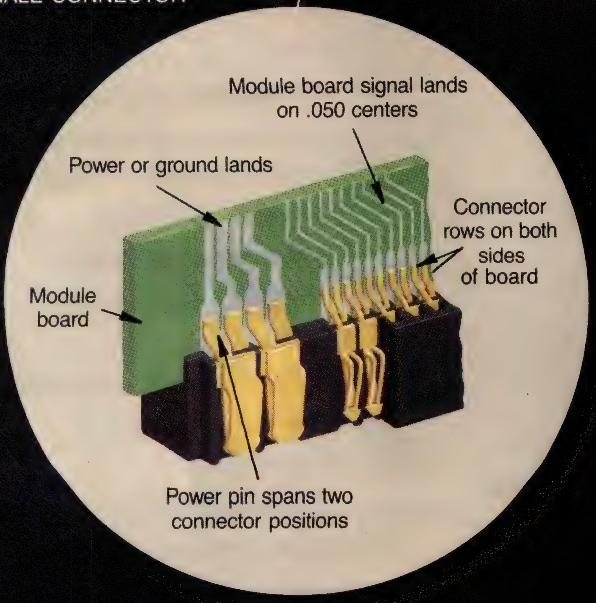
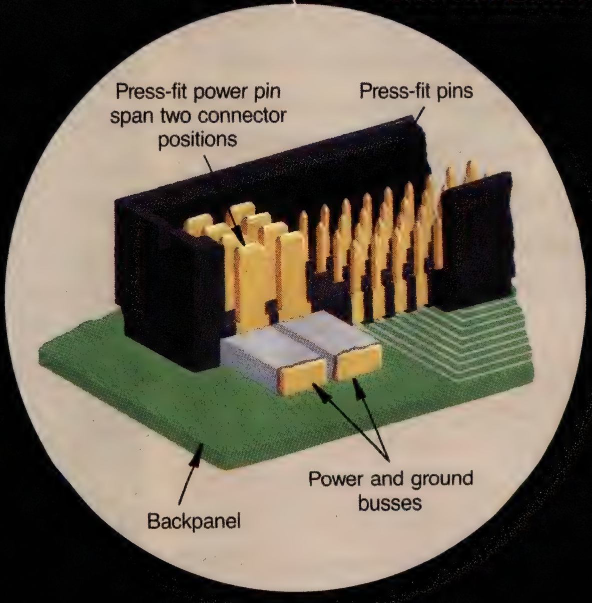

Module board signal lands on .050 centers
Power or ground lands
Connector rows on both sides of board
Module board
Power pin spans two connector positions

MALE CONNECTOR



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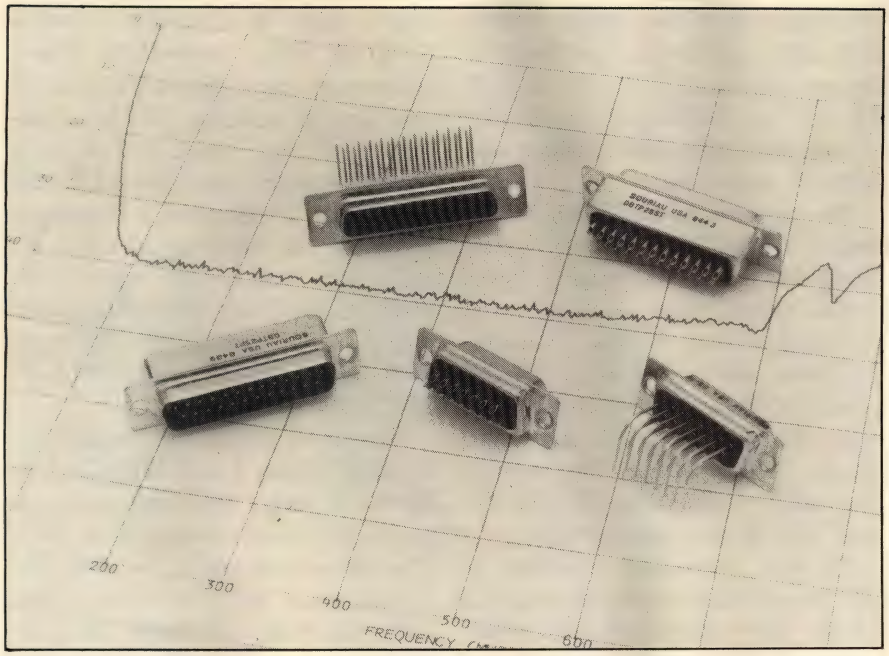
ELFAB
INTERCONNECTION
INNOVATORS

CIRCLE NO 52

Suitable for telecommunications applications, *Burndy's 50-position panel-mounted I/O connector employs a planar ceramic capacitive array that provides individual bypass circuits for each signal line. The part offers capacitance values of 50 to 1000 pF, and its tail geometry provides a convenient means of mass terminating 50-conductor ribbon cable.*



You can specify either planar C or tubular π filter networks *in Souriau's line of D-subminiature connectors. The five models in the company's π connector family attenuate from 5 to 65 dB over a frequency range of 2 to 1000 MHz.*

filter connector can either employ a single capacitive or inductive element or incorporate various combinations of capacitive and inductive elements.

The capacitive filter elements can be tubular, planar, or chip capacitors. Tubular capacitors are sleeve-like devices that slide over individual connector contacts. A fully filtered 25-pin D-subminiature connector, for example, would employ 25 of these parts.

Because tubular capacitors are expensive, connectors using them for filtering are also expensive—they cost from $0.80 to $1.30 per line. These connectors are also difficult to assemble: The capacitors must be inserted between the connectors' contacts and ground. In fact, some manufacturers won't assemble these connectors; instead, they'll sell you the individual filter elements and let you assemble the connectors yourself.

In a planar filter connector, the capacitor is a slab of ceramic material that has holes to accommodate the connector's contact pins. These connectors are easy to assemble: The manufacturer simply slides the ceramic piece over the contacts and solders it in place. For a D-subminiature connector, the ceramic slab typically measures about 2×0.5×0.1875 in. The slabs' shape makes them fragile, so connectors employing this filtering technique don't withstand mechanical shock very well. (For instance, if you were to drop one of these connectors from a height of a few feet, the ceramic slab would probably break.) They are, however, less expensive ($0.50 to $0.80 per line) than connectors using tubular capacitors.

The least expensive filter connectors you can buy are those that use surface-mount chip capacitors as the filter elements. These connectors cost from $0.20 to $0.30 per line. The chip capacitors, which mount on individual lines between the contacts and the connectors' ground shells, are almost perfectly cubical, so they withstand mechanical shock well and require no special handling.

The inside story

The most common filter configurations in use are the C and the π types. The C filter employs a simple capacitive element in shunt between the connector's contact and ground (the connector shell); the π configuration uses an inductive element that's connected in series with two capacitive elements, which are shunted to ground (see EDN, April 11, 1985, pg 95). Because they're made of multiple elements, π filter connectors are more expensive than C versions. For most computer applications, however, you can meet FCC EMI/RFI regulations by using the less-expensive C filters.

Aside from their configuration, C and π filters differ mainly in insertion-loss performance. The π filters have a sharper insertion-loss slope. That is, for identical capacitance values, they provide higher attenuation at any given frequency than do C configurations.

Single-element devices

For attenuating signals as high as 100 MHz, however, the less-expensive C filter connector performs almost as well as the π type. Burndy offers C filter connectors that use planar capacitive arrays as the filtering elements. One such part is a 50-position, panel-mounted I/O connector whose contact-tail geometry provides a convenient and reliable mechanism for the mass termination of standard 26- and 30-AWG solid-wire or 28-AWG stranded-wire ribbon cables.

The capacitive array provides individual bypass circuits for each signal line. Auxiliary pressure contacts and two grounding springs, all of which are part of the main contact spring, provide an electrical connection for the capacitor, which is available with a value of 50 to 1000 pF.

The Burndy connectors have a 0 to 70°C operating range and a 94V-0 UL flammability rating, and they can carry 1A at 500V. They offer 0.02Ω max contact resistance and a 1000V dielectric withstanding voltage. The capacitive arrays' contact pads have 10-μin. gold plating over nickel plating. The copper-alloy connector contacts have 30-μin. min gold plating on mating and filter-contact areas, and 100-μin. min solder plating on the insulation-displacement tails. The copper-alloy grounding springs are completely covered with 75-μin. nickel plating.

Du Pont's D-subminiature C filter connectors also employ a planar filter technique. The capacitor system, a thick-film capacitive network on an alumina substrate, uses palladium/silver for the electrodes, barium titanate for the dielectric, and two types of glass for the encapsulant. The glass also provides an appropriate transition in thermal coefficients of expansion between the alumina and dielectric.

The D-subminiature connectors are available in 9-, 15-, 25-, and 37-pin versions and three capacitance values—380, 600, and 1000 pF. Over a frequency range of 30 to 1000 MHz, minimum insertion-loss figures spec at 2 to 30 dB, 3 to 30 dB, and 7 to 30 dB, respectively, for connectors with 380-, 600-, and 1000-pF capacitors.

The connectors feature a flame-retardant (per UL 94V-0), glass-filled thermoplastic housing, steel shells, brass male contacts, and phospher-bronze female contacts. The pins are plated with 15-μin. gold over 50-μin. nickel; the sockets have 30-μin. gold plating over 50-μin. nickel plating. The connector's solder tails have 100-μin. tin/lead over 50-μin. nickel plating.

All the connectors operate at 100V dc and have a current rating of 1A dc. They offer insulation resistance of $10^9\Omega$ min at 100V dc and 25°C. Their dielectric withstanding voltage (at 25°C) measures 250V dc, and their dissipation factor equals 10% max at 1 kHz.

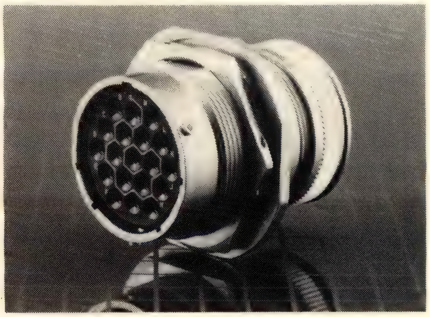
The Du Pont D-subminiature connectors can withstand 100 mating/unmating cycles, and they operate over −25 to +85°C. They can operate in 85% relative humidity (40°C) for 300 hours, and they meet MIL-STD-1344 mechanical shock and vibration requirements.

For good attenuation of signals higher than 100 MHz, you should choose a connector that uses a π filter, such as Deutsch's Series 81060 π filter connectors. These connectors are available with size 12 and size 24 contacts. Under a no-load condition, insertion loss for a size 12 contact (per MIL-STD-220) is at least 50 dB over a frequency range of 100 MHz to 10 GHz. At 85°C, the connectors operate at 800V dc, 300V ac. The contacts can carry 25A, and their insulation resistance (tested per MIL-F-15733) is $5\times10^9\Omega$ min.

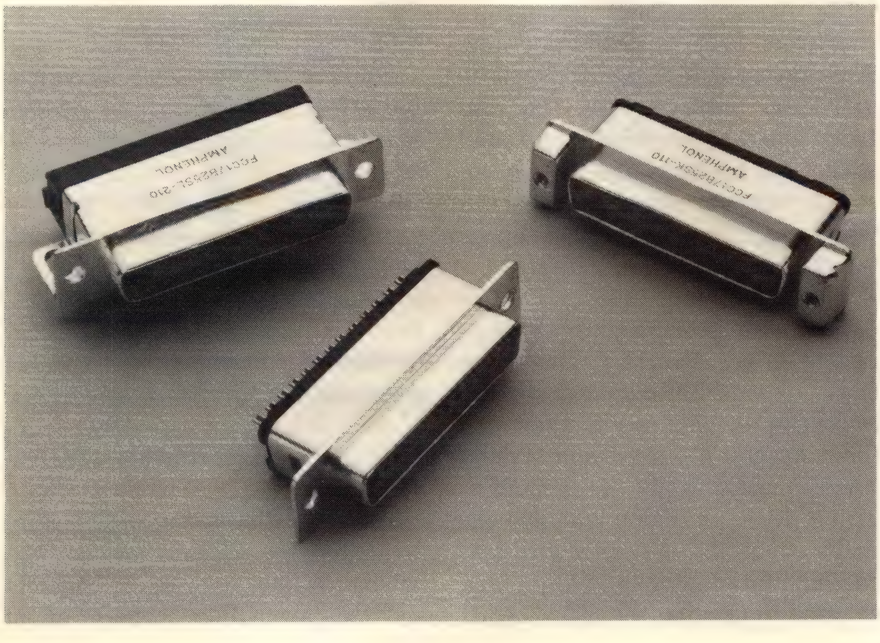
The parts, which mate with MIL-C-26482 Series 2 and MIL-C-83723 Series 2 plugs, offer minimum capacitance values of 3000 pF at 25°C. The connectors are made of an aluminum alloy with a nickel finish; their contacts are made of gold-plated copper alloy. The connectors feature jam-nut mounting and a bayonet coupling mechanism.

A choice of technologies

Souriau's filter connectors offer both C and π filter networks. The parts come in both circular and rectangular (D-subminiature) versions. Circular versions meet MIL-C-38999 Series 1 and 2 and MIL-C-26482 G Series 1 and 2; rectangular versions meet MIL-C-24308 specifications. Rectangular connectors employ planar capacitive arrays; both circular and rectangular con-



For high-frequency filtering applications, *AFD type Series 81060 pin receptacles from Deutsch spec a no-load insertion loss (per MIL-STD-220) of 50 dB min from 100 MHz to 10 GHz.*



The stress-isolated chip-capacitor filter networks *in Amphenol's FCC 17 Series connectors minimize the units' susceptibility to shock and vibration. You can use these connectors as drop-in replacements for filterless connectors in existing designs.*

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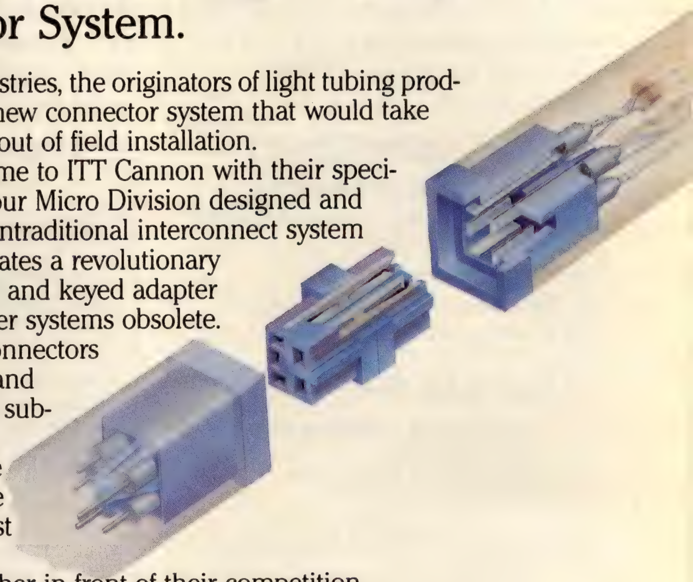

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ITT CANNON
THE GLOBAL CONNECTION

CIRCLE NO 53

nectors are available with π tubular filters. (If you choose the tubular-filter connectors, you can specify which pins or sockets will have filters.) The circular models come with solder-cup or straight pc-board terminations; the rectangular units are available with solder-cup, straight pc-board, or right-angle pc-board terminations.

Capacitance values for the Souriau connectors range from 200 to 100,000 pF; cutoff frequencies (−3 dB) span 0.5 to 40 MHz. All the connectors operate over −55 to +125°C. Their voltage and current ratings range from 50 to 200V dc and 5 to 13A, respectively, depending on filter type. The five models in the π connector family spec insertion losses of 5 to 65 dB over 2 to 1000 MHz.

AMP's Quiet Line connectors are also available with a choice of capacitive (C) and distributive-element (π) filters. C filter units come in 9-, 15-, 25-, and 37-position pin and socket versions and offer maximum capacitance values from 400 to 2500 pF. Depending on the connector family, typical insertion-loss figures range from 3 dB (at frequencies of 3 to 25 MHz) to anywhere from 32 to 48 dB at 1 GHz. Maximum voltage and current ratings for the connectors are 100V dc and 5A, respectively. The units' insulation resistance specs 1 GΩ min, and their dielectric withstanding voltage is 250V dc for 5 sec.

The π Quiet Line filter connectors feature a 1-piece titanate-coated lossy ferrite sleeve with an inner contact that's permanently attached. The connectors offer impressive insertion-loss performance at high frequencies: At 1 GHz, for example, typical insertion-loss figures range from 26 to 100 dB, depending on the capacitance value. At 18 GHz, insertion loss ranges from 44 to 100 dB typ.

The connectors are rated to 100V dc over −25 to +85°C; their load current rating is 15A. They spec a minimum insulation resistance of either 500 MΩ or 1 GΩ (depending on the part family); the dielectric withstanding voltage is 250V dc.

Drop-in-replacement connectors

Besides incorporating filter connectors in your new designs, you can replace filterless connectors

For more information . . .

For more information on the filter connectors discussed in this article, circle the appropriate numbers on the Information Retrieval Service card or contact the following manufacturers directly.

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Circle No 730

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CIRCLE NO 54

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CIRCLE NO 55

SPOTLIGHT #19
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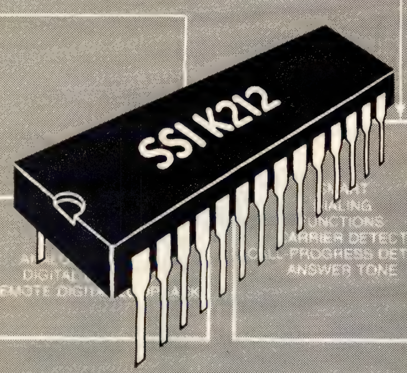

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The one-chip K212 provides functions on a single chip which were previously only possible using many separate components. The new one-chip modem IC simplifies the design problem for users who are building modems for personal computer applications, and it is ideal for use in any self contained or integral modem system. The K212 provides exceptional performance under poor line conditions, and allows all Bell 212A operating modes.

For more information, contact: **Silicon Systems**, 14351 Myford Road, Tustin, CA 92680, **(714) 731-7110**, Ext. 595.

silicon systems
INNOVATORS IN INTEGRATION

CIRCLE NO 56

with filter connectors in existing systems. This way, you can make an existing system meet FCC EMI/RFI requirements without having to make expensive and time-consuming system modifications.

Because they have the same dimensions as their filterless counterparts, the FCC 17 Series D-subminiature filter connectors from Amphenol can be drop-in replacements for the company's filterless D-subminiature connectors in existing systems. The connectors' chip-capacitor filter network is stress isolated, so the connectors withstand shock and vibration well.

FCC 17 Series connectors employ barium titanate chip capacitors that feature stable insertion-loss characteristics. They come in 9-, 15-, 25-, and 37-position pin and socket configurations. The connectors operate over −40 to +85°C, and, according to the manufacturer, they are not likely to experience any changes in capacitance value over 10 years. Insertion-loss figures for the connectors range from 3 to 20 dB over a frequency range of 30 to 100 MHz.

The connectors' shells are constructed of die-cast zinc with tin plating. The contacts are of copper alloy with 20-μin. gold plating on the interface area and with tin plating on the termination ends. You can choose solder-cup and straight or 90° pc-board terminations, and you can specify the connectors with any combination of filter, power, and ground contacts.

Certain π connectors, such as the TKJ Series from Cannon, can also be drop-in replacements for filterless connectors. These connectors have the same layout pattern and contact spacing as their filterless counterparts. Unlike typical filterless connectors, however, the TKJ Series parts don't have removable contacts.

The TKJ filter connectors are available in low-frequency (L), mid-frequency (M), standard-frequency (T), and high-frequency (H) versions. The units' attenuation performance specs 2 to 90 dB min over 0.1 to 1000 MHz (L), 2 to 90 dB min over 1 to 1000 MHz (M), 2 to 60 dB min over 2 to 1000 MHz (T), and 2 to 50 dB min over 10 to 1000 MHz (H). They operate at 200V dc, 120V ac rms at 400 Hz. The parts' current rating varies with the size of their contacts—connectors with size 16 contacts carry 15A, parts with size 20 contacts carry 7.5A, and parts with size 22 contacts carry 5A.

TKJ connectors with solder-pot, printed-circuit, crimp-piggyback, or wire-wrapping terminations meet the applicable portions of MIL-C-38999 Series 1, 2, or 3. The parts can have as many as 128 contacts, which can be size 16, 20, or 22. All the connectors can operate over −55 to +125°C without significant changes in insertion-loss characteristics. The connectors have an aluminum-alloy shell and copper-alloy, gold-plated contacts. A silicone-based elastomer provides an environmental seal, and the beryllium copper grounding spring is plated with silver. **EDN**

Article Interest Quotient
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Simplifies Modem Design and Manufacturing

The one-chip K212 represents a new level of integration for modem IC's. It provides functions on a single chip which were previously only possible using many separate components. This new single-chip modem simplifies designs for users who are building intelligent modems, or who wish to incorporate datacommunications capability into specialized systems. A complete modem requires only the addition of the phone line interface and a control microprocessor. The K212 is ideal for use with any self-contained or integral modem system that incorporates a dedicated microprocessor for control and command interpretation.

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INNOVATORS IN INTEGRATION

For product information Circle 12

For career information Circle 11

Anti-aliasing enhances measurement confidence. Signal distortion (sample mode only) is shown at high frequencies (top). The peak detect mode displays peak information without signal distortion (bottom).

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INTRODUCING TWO DIGITAL STORAGE SCOPES WITH SOME MIGHTY IMPRESSIVE NUMBERS.

Features	2230	2220
Analog/Digital Storage Bandwidth	100 MHz	60 MHz
Single Shot (Transient) B.W. (10 points per signal period)	2 MHz	2 MHz
Maximum Sampling Speed	20 MS/s	20 MS/s
Record Length	4K/1K (selectable)	4K
Save Reference Memory	One, 4K Three, 1K	One, 4K
Vertical Resolution	8 bit 10 bit (avg mode)	8 bit
Peak Detect	Yes (100 ns)	Yes (100 ns)
Averaging	Yes (menu-selectable)	Yes (rep. sampling)
X-Y Storage Bandwidth	100 MHz	60 MHz
GPIB/RS-232-C Options	Yes (talker/listener, includes 26K of battery-backed memory)	Yes (talker/listener)
Price	$5150	$4150

From 4K record length to 20 MS/s sampling at 100 MHz or 60 MHz... our two new scopes have just what you're looking for! The 2230 and 2220 are powerful digital storage oscilloscopes—and the first scopes in their class that include non-storage capability to these bandwidths.

You can reference, compare, and analyze waveforms with digital storage convenience, plus the confidence you get with analog measurements. Simply switch to the non-store mode to view the signal that the scope has digitized. Only Tek offers this flexibility to 100 MHz and 60 MHz in affordable scopes.

Enhancing use of the scopes as design and troubleshooting tools are fast sample and hold detector circuits, plus the proprietary peak detect mode. They enable the display of pulses as narrow as 100 ns at any sweep speed—even on a single sweep.

You'll also find such features as post-acquisition expansion and compression, X-Y capability to each scope's storage bandwidth and, for systems use, optional GPIB or RS-232-C interfaces.

Best of all, the 2220 and 2230 are easy to use and afford. And backed by Tek's famous 3-year warranty that includes the CRT. Check the front panels. The controls are familiar, comfortable, easy to identify. Designed to push productivity and minimize training time.

In the 2230, CRT readout of front panel settings and key parameters means even more convenience, with cursors for waveform voltage and timing measurements.

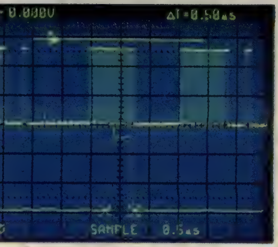
Get the reliability and performance you expect in Tek scopes, now enhanced by digital storage, at unexpected prices: $4150 for the 2220, $5150 for the 2230.

For the full story, and more impressive numbers, contact your local Tek Sales Representative today. Or call the Tek National Marketing Center,

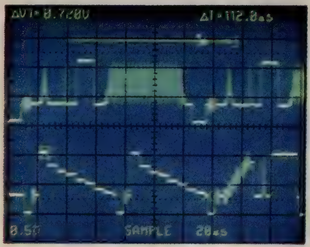
1-800-426-2200.

In Oregon, call collect,

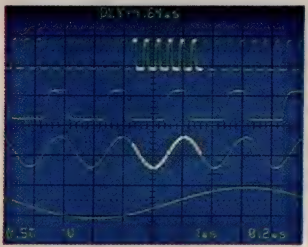
(503) 627-9000.



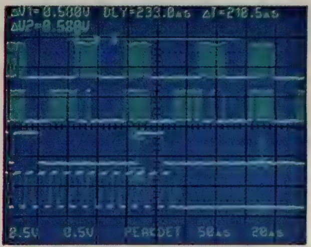
-screen viewability lets you and, compress, and position eforms saved in reference mory. This permits easy view- and display flexibility of up ight saved waveforms.



High display resolution and accuracy permits on-screen viewing of signals such as the TV test signal shown here. 4K of record information can be viewed in 1K windows.



100 MHz, non-storage capability comes standard in the 2230. In addition, there's dual channel, dual timebase, versatile triggering and CRT readout.



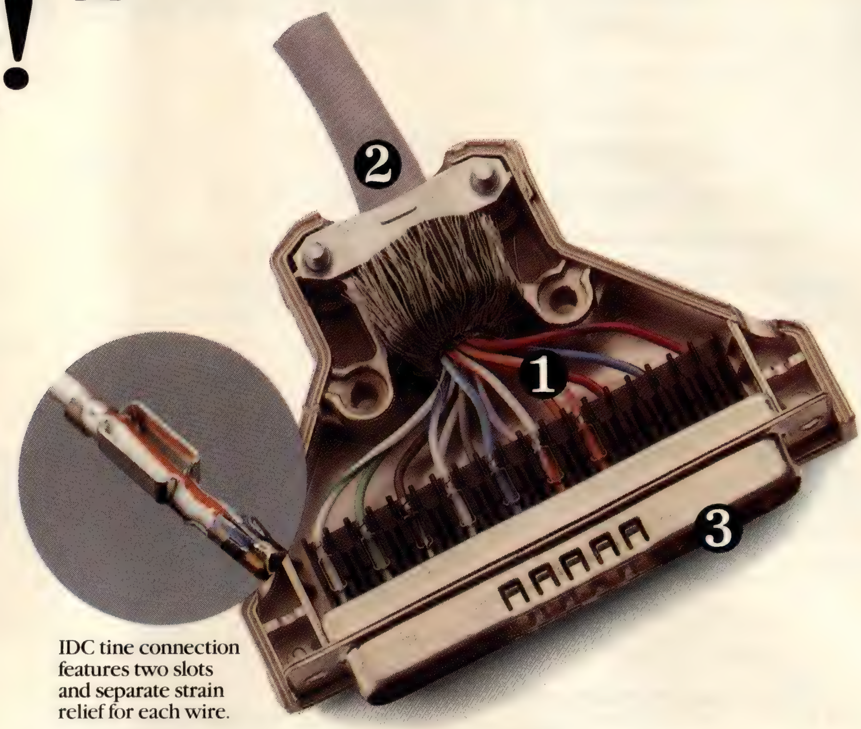
The 2230 offers the convenience of CRT readout in both storage and non-storage modes at 100 MHz. Storage mode cursors make ΔV, ΔT, and 1/ΔT measurements fast and easy.

Tektronix®
COMMITTED TO EXCELLENCE

CIRCLE NO 57

End time-wasting "hunt & poke" wiring!

IDC contacts offer more efficient high speed wiring of new RN D-Sub discrete wire connectors.



IDC tine connection features two slots and separate strain relief for each wire.

Insulation Displacement Contacts in these new DDM Series D-Sub discrete wire connectors cut wiring time, improve productivity over old "hunt & poke" wiring. No more clumsy wire stripping or inconsistent terminal crimping. Just push wire into pre-loaded IDC contact and you've made a fast, gas-tight, visually verifiable connection. And these new D-Sub connectors are available with selective contact loading to meet your specifications.

Because EMI/RFI shielding is so important, RN has incorporated flexible "grounding fingers" in the male D-Sub connector cowl. These new RN "grounding fingers" provide compliant fit to the mating cowl for reliable grounding and shielding effectiveness over extended connector cycling.

Application tooling.
RN offers economical tooling for individual wire insertion or mass termination. The arbor press, the hand tool, and a contact replacement kit are available.

❶ **"Selective Contact Loading."** You specify the contacts needed for your circuitry. RN pre-loads them into the insulator in your desired pattern. Pin push out problems are eliminated…"hunt & poke" wiring mistakes can't happen with this foolproof discrete wire D-Sub connector.

❷ **Separate Strain Relief and Shield Connection.** These two critical functions are physically separated. This ensures reliable shielding even when the cable is flexed.

❸ **Flexible "fingers" offer better grounding.** Where competitive connectors have simple dimples or no grounding at all, these RN "fingers" provide positive grounding and excellent EMI/RFI shielding over prolonged cycling.

WRITE TODAY for complete catalog on the full line of I/O CONNECTORS offered by Robinson Nugent. Contains data on real-life tests that provide assurance of field performance and long term reliability. Contact: Robinson Nugent, Inc., P.O. Box 1208, New Albany, IN 47150. Phone: (812) 945-0211.

CIRCLE NO 58

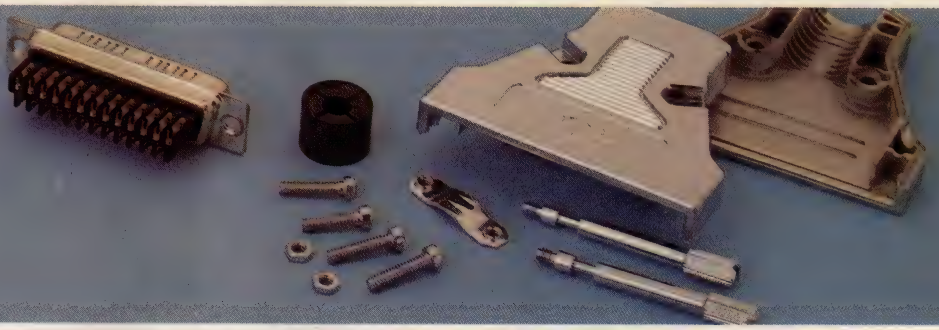
CONNECT WITH QUALITY

More cost effective I/O Connectors to make the Robinson Nugent "Quality Connection"

CONNECTORS AND BACKSHELLS

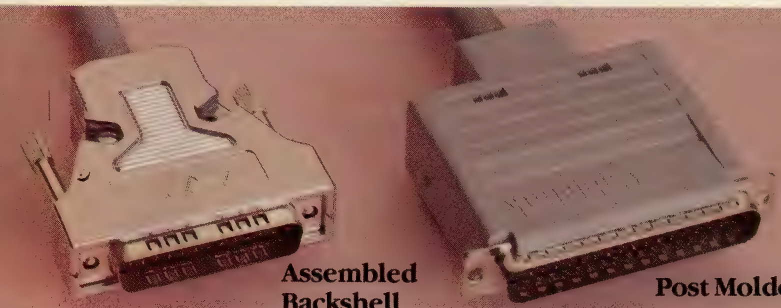
Connectors available in both plug and socket versions with backshells (9, 15, 25 and 37 positions) supplied separately.

CIRCLE NO 59



RN CABLELINK ASSEMBLIES

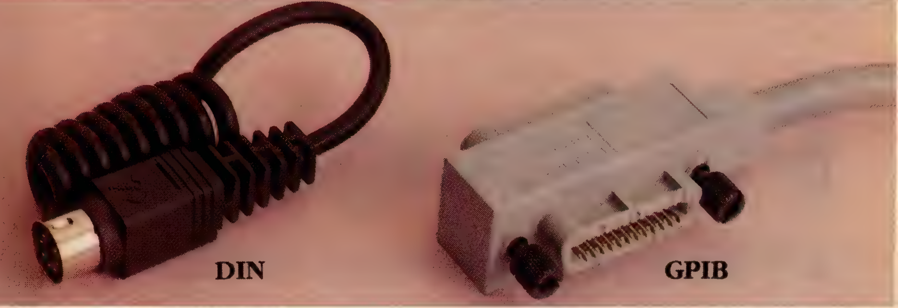
D-Sub Assemblies


Assembled Backshell

Post Molded

CIRCLE NO 60

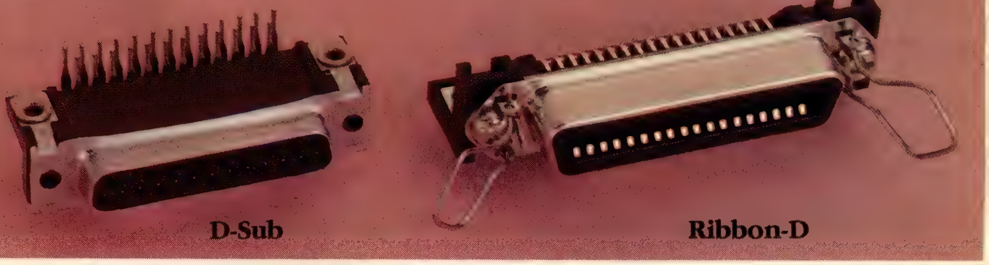
Other post molded styles


DIN

GPIB

CIRCLE NO 61

PC MOUNT SOLDER TAIL CONNECTORS


D-Sub

Ribbon-D

CIRCLE NO 62

Robinson Nugent

800 East Eighth Street, New Albany, Indiana 47150 • Phone: (812) 945-0211
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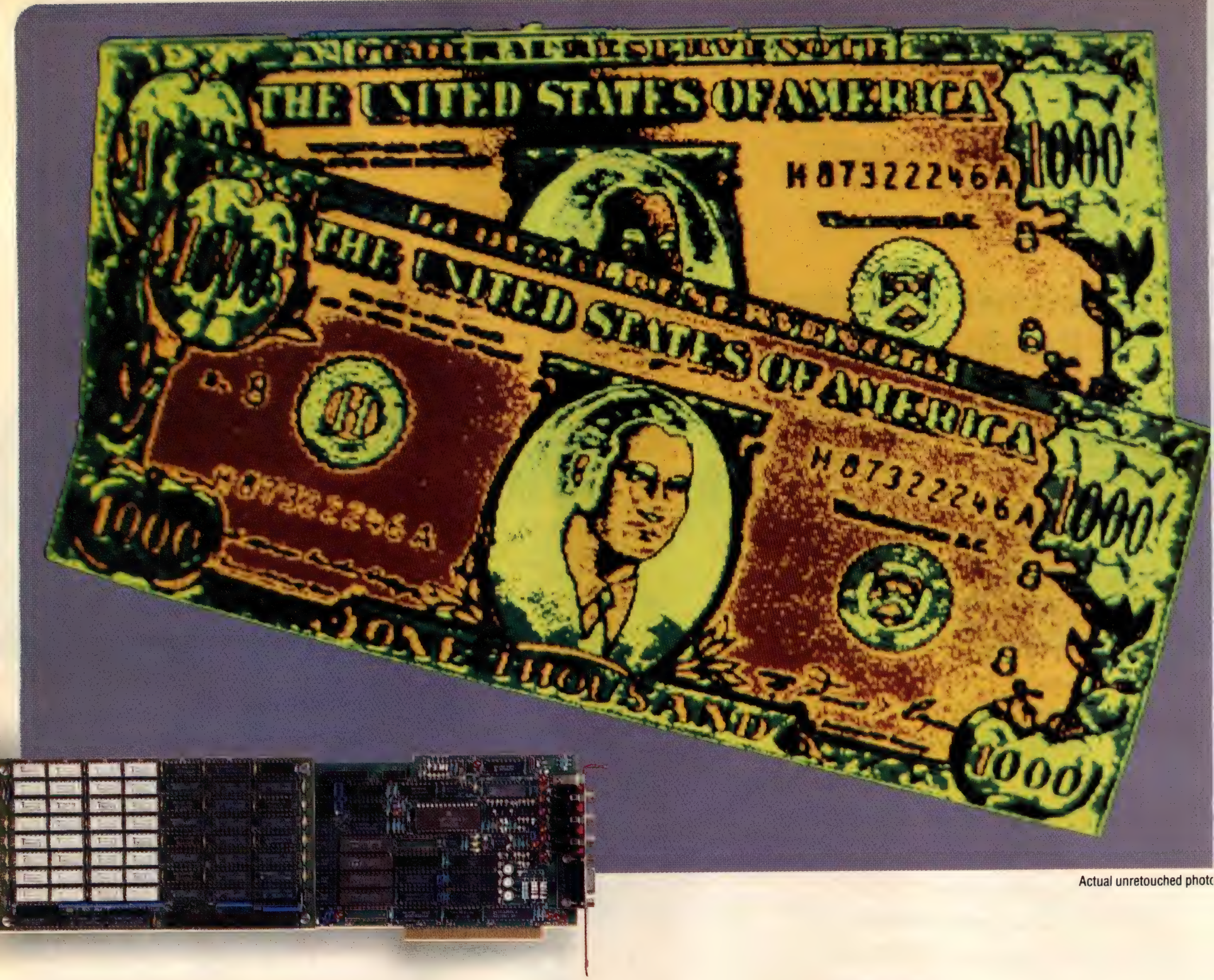

Actual unretouched photo

PC Imaging... $1995.00

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- 256 colors/gray shades
- 16.7 million color output lut
- Real-time 8-bit frame grab
- DMA image transfer — 1M pixels/sec.

Matrox now offers two new image processing boards, the PIP-512 and PIP-1024. The PIP series of boards provides complete 8-bit image acquisition, frame buffering, and display capability for the IBM PC. A PIP board upgrades th PC, XT or AT into a LOW COST, PROFESSIONAL image processing workstation.

The PIP boards have all the high performance features characteristic of top-of-the-line image processing systems with one exception: price.

The PIP-512 sells for only $1995.00 in single quantity.

For more info on MATROX PC imaging; CALL TOLL FREE 1-800-361-4903.

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CIRCLE NO 63

High-speed logic-to-logic optocouplers provide LSTTL-to-TTL or -CMOS interface

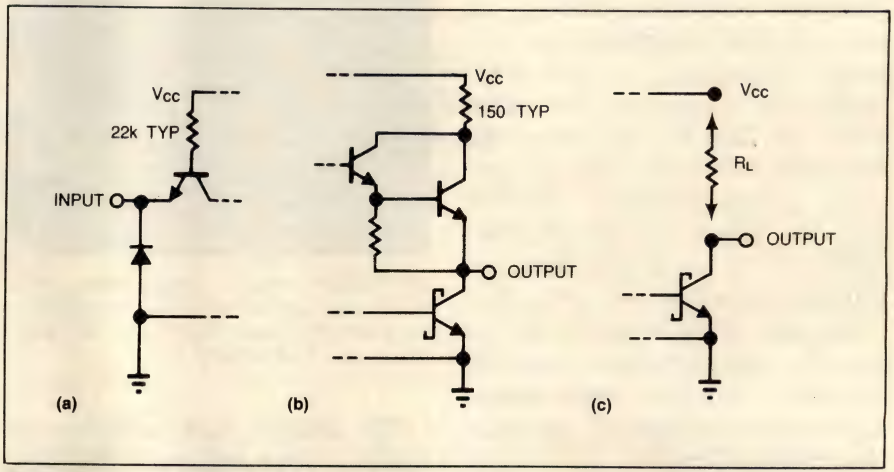


*Fig 2—**Logic-compatible input and output stages** allow the 74OL6000 family of optocouplers to accept LSTTL-level inputs **(a)** and to drive TTL **(b)** or CMOS **(c)** loads.*

The 74OL6000 Series optocouplers provide an interface between LSTTL and TTL or CMOS circuitry. The family is available in LSTTL-to-TTL buffer or inverter configurations and in LSTTL-to-CMOS buffer or inverter versions. The interface ICs accommodate data-communication rates as high as 15M bps.

In all four devices (**Fig 1**), the input stage provides LSTTL compatibility. The output stage for the LSTTL-to-TTL units uses the classic totem-pole configuration shown in **Fig 2b**; the totem-pole outputs provide a fanout of 15 TTL loads. For the LSTTL-to-CMOS units, an open-collector output (**Fig 2c**) accommodates power-supply voltages between 4.5 and 15V.

The ICs' input stage switches a temperature-compensated current source that drives a high-speed GaAsP/GaAs LED emitter. This emitter is optically coupled to an integrated photodetector that drives an output-amplifier IC. The devices' optically transparent noise shield provides 15-kV/µsec common-mode noise rejection.

The optocoupler family specs typical propagation delays of 60 nsec. The ICs are housed in 6-pin DIPs, and they can withstand a test voltage of 2500V rms for one minute (equivalent to a continuous working voltage of 440V rms). $2.55 (1000).

—Bill Travis

General Instrument, Optoelectronics Div, 3400 Hillview Ave, Palo Alto, CA 94304. Phone (415) 493-0400.

Circle No 745

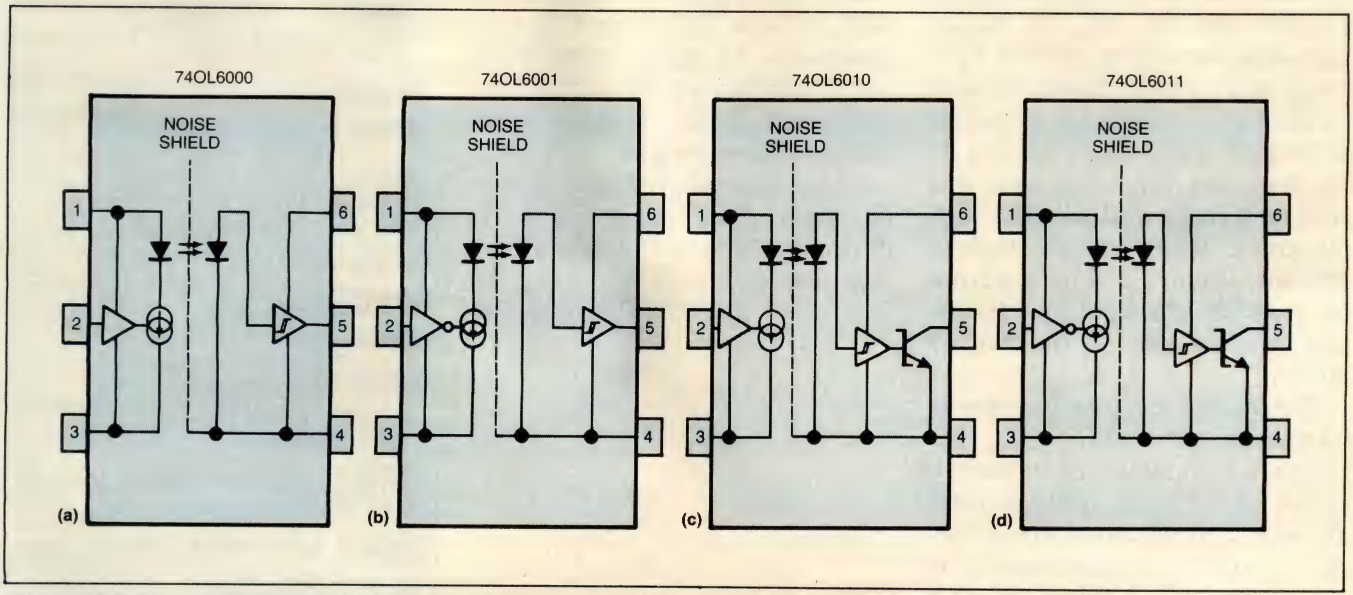


*Fig 1—**LSTTL compatibility and high isolation voltages** are two useful attributes of the 74OL6000 Series optocouplers. You can choose an LSTTL-to-TTL buffer or inverter **(a, b)** or LSTTL-to-CMOS devices **(c, d)**. The ICs provide 2500V rms isolation and operate at baud rates as high as 15M bps.*

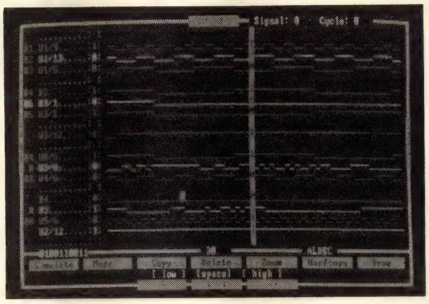
Hardware-development tools link μPs, arrays, and PLAs

The Master Schematic Logic Analyzer and companion products let you translate schematics into μP-based, PLA-based, or gate-array designs for a relatively low price. With an IBM PC or compatible computer, the logic analyzer provides schematic-capture capabilities. Its output can be μP code, ANSI PLA program files, or Fujitsu-compatible gate-array files.

The logic analyzer and its suite of options—which include graphics schematic capture, Alice (Aldec logic in-circuit emulator), the Logic Networking Compiler, and various libraries—run on an IBM PC with an enhanced graphics adapter. The Master logic analyzer costs $2850; you can choose either net-list or logic-equation data entry. Graphics schematic capture is an additional $1600. Libraries of standard ICs (7400 TTL or CMOS, for example) cost around $1250 each.

Although a complete schematic-capture, simulation, and in-circuit emulator system costs around $10,000, you can use the Master logic-analyzer system without additional large expenditures. Typically, the logic analyzer can transform a 100-gate schematic, including 10 flip-flops and three counters, into code for a single 8751 μP. This sample circuit, which consists of about 26 chips, requires 2.5k bytes of code for the 8751. The logic analyzer can also generate code for the 6804 μP family.

The Master analyzer includes an interactive simulator, which can complete a simulation on the sample circuit in 1.7 msec. The simulator allows you to set inputs and breakpoints, and to monitor outputs or any circuit node. Unlike some IBM PC-based simulators, this simulator requires no auxiliary processor.



User-defined ***inputs, breakpoints,*** *probe points, and outputs make the Aldec simulator a powerful tool for pc-board, μP, gate-array, and PLA design.*

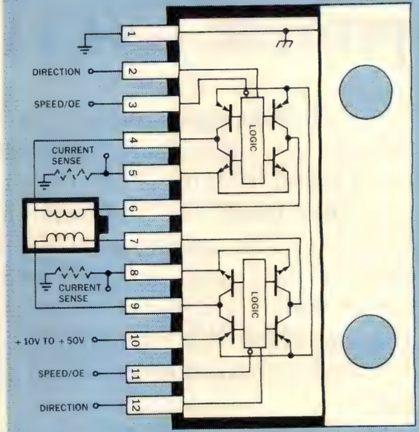
The Master logic analyzer can break a large schematic into segments and produce different types of output for each segment. A $3000 option, the Logic Networking Compiler, produces code for multiple parallel μPs to replace circuits too complicated for a single processor.

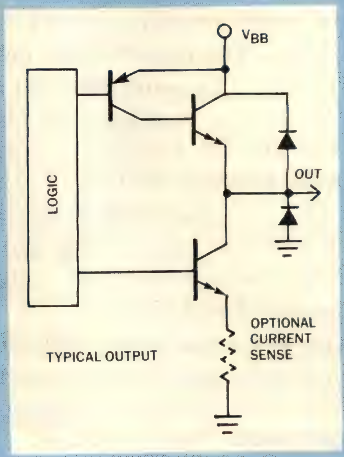
The Alice hardware/software package allows you to connect the design you created on the PC to its intended hardware environment, enabling you to debug your design before building it. The Alice hardware includes PROM and 8751 programmers, 32 digital ouput lines, and 32 digital input lines. The Alice hardware/software package costs $3900.—***Maury Wright***

Aldec-Automated Logic Design Co, 3525 Old Conejo Rd #111, Newbury Park, CA 91320. Phone (805) 499-6867.

Circle No 744

SPRAGUE
PIC





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DUAL FULL-BRIDGE MOTOR DRIVER
for 2-Phase Stepper, or Brushless DC Motors

- Load Voltages to 50 V
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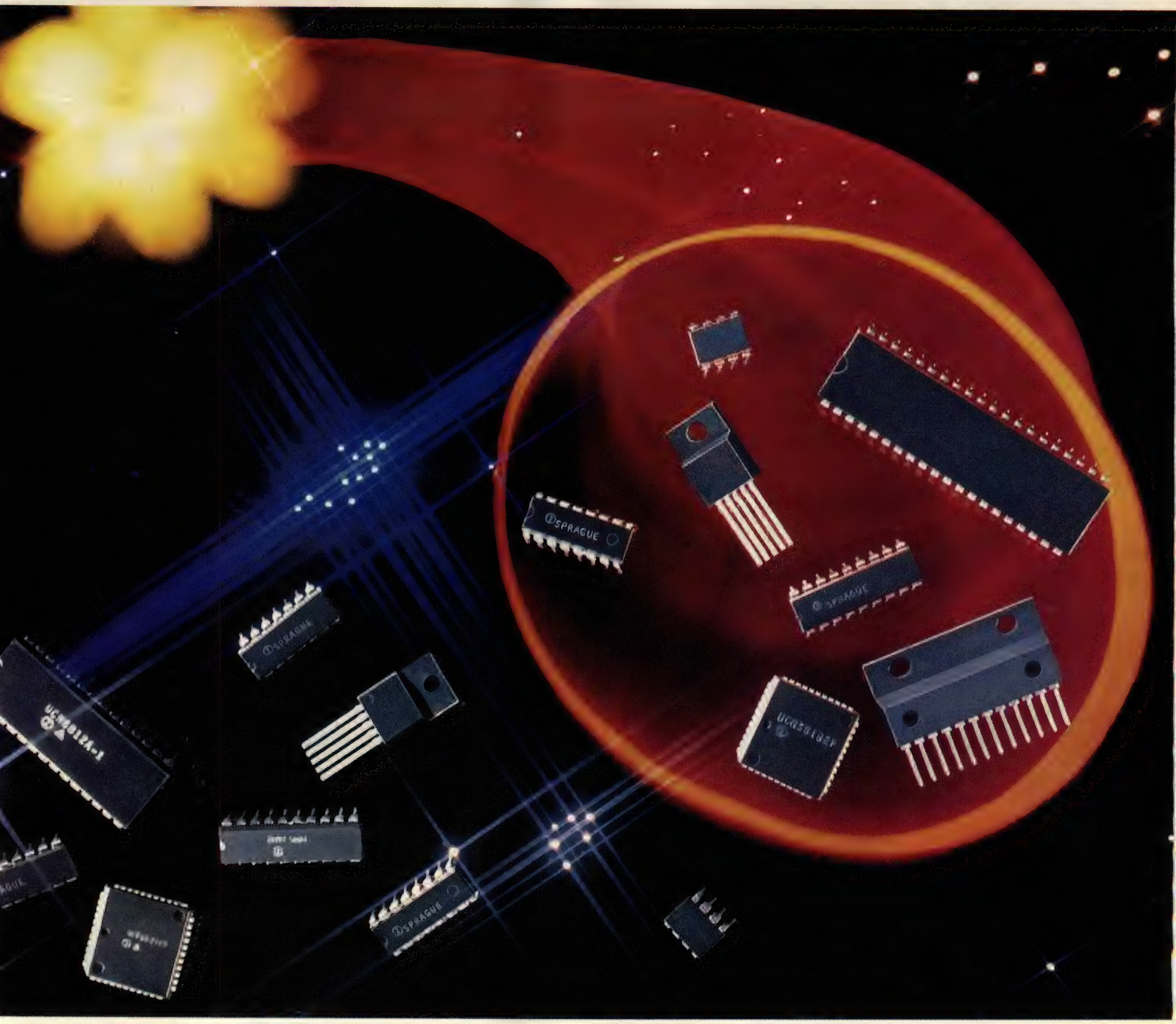
- 12-Pin Power-Tab SIP
- Clip-On Heat Sink Available

Write for Engineering Bulletin 29319.6 or:

CHECK 64 ON READER SERVICE CARD.

SPRAGUE
THE MARK OF RELIABILITY

ORIGIN.



4SS-5120

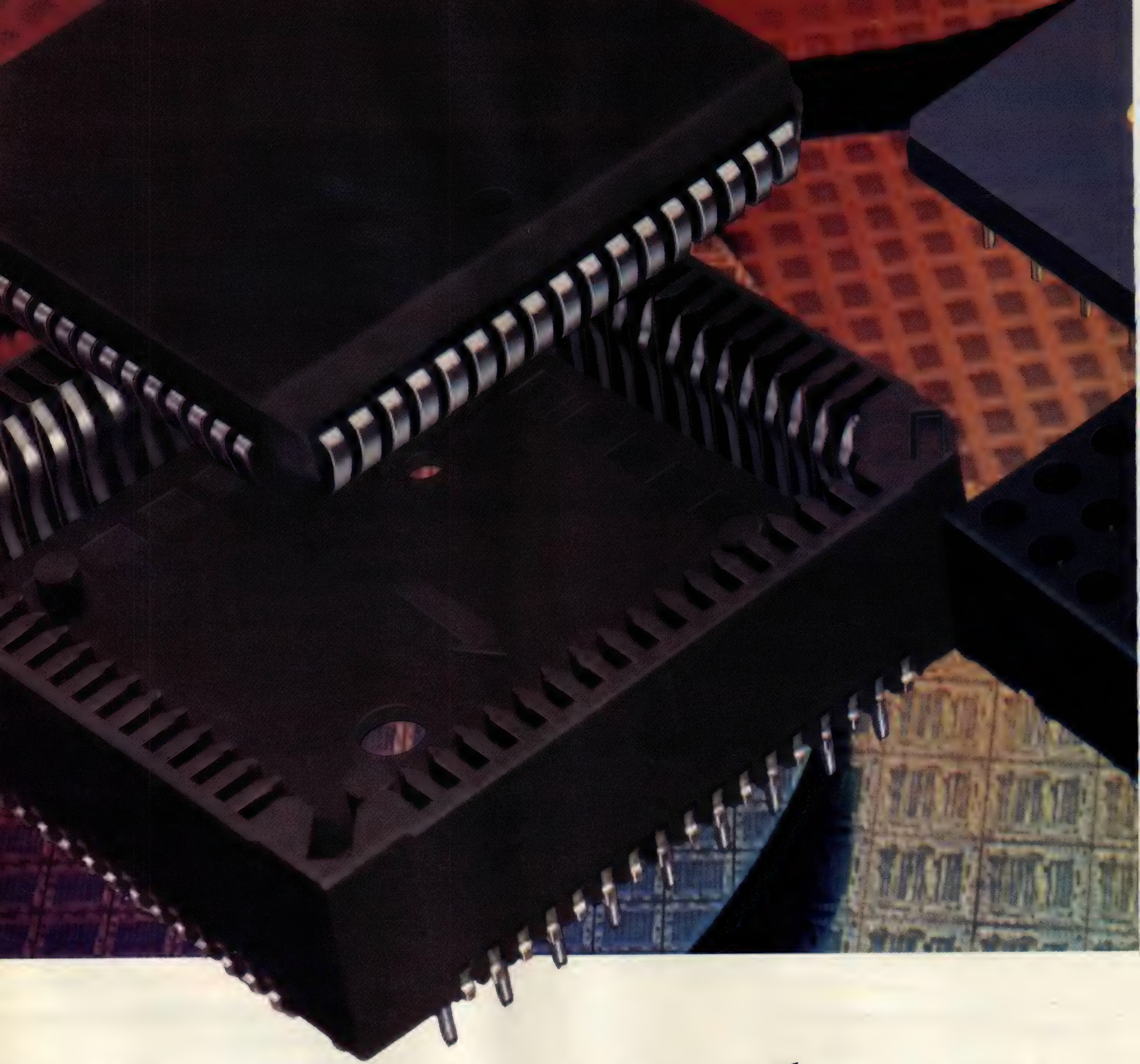
SPRAGUE IS THE SOURCE FOR POWER INTERFACE.

Sprague continues as the innovator in power interface with the broadest assortment of current-sourcing power drivers. You can get them with high voltage (to 200 V), high current (to 4A per output), and smart-power BiMOS. Functions are available from 4 to 32 sourcing outputs; many combined with shift-registers, latches, decoders, etc. They fit many commercial/military applications including automotive, telecommunications, printers and other peripherals, plus business machines.

Sprague Electric Company, a Penn Central unit, World Hdqtrs., Lexington, MA. For Brochures WR-172C, WR-189 nd WR-203, write to Technical Literature Service, Sprague Electric Company, P.O. Box 9102, Mansfield, MA 02048-9102. For applications assistance, call Mark Heisig or Tom Truax at (617) 853-5000.

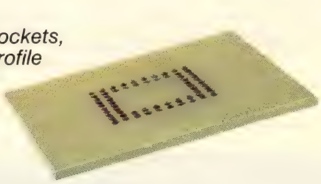
SPRAGUE
THE MARK OF RELIABILITY

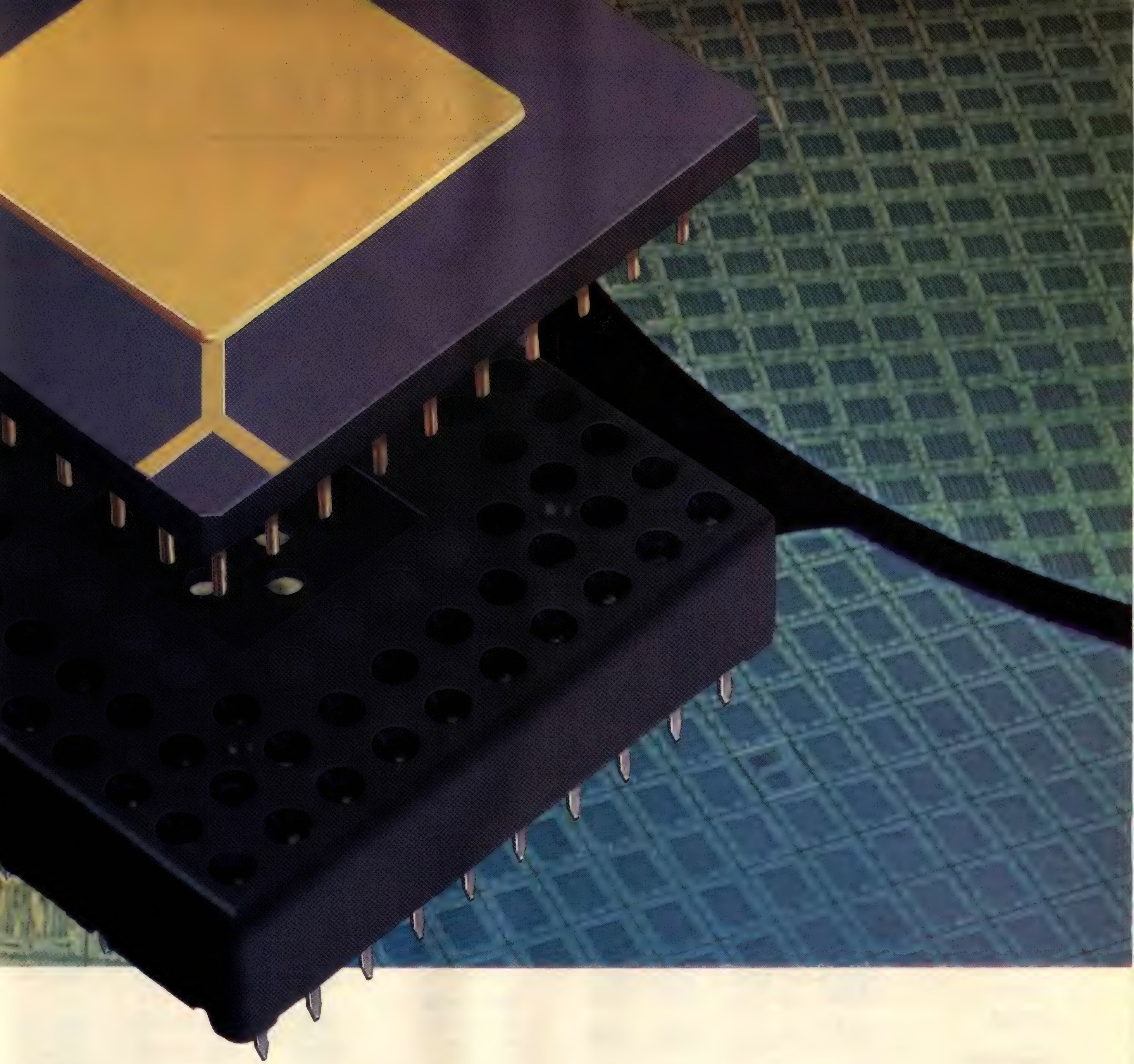
CIRCLE NO 65



How we've made sure the chip's locked in, but you're not.

ZIF and LIF PGA sockets, plus our minimal profile spring sockets in PGA footprint.





Whichever direction you take in microprocessor technology, AMP makes sure you have the socketing options you need to make it pay off.

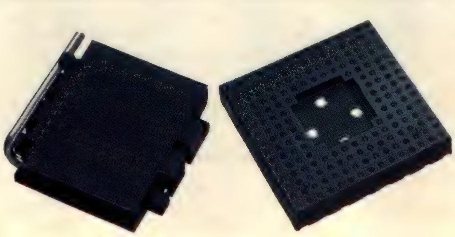
Our high pressure tin sockets for plastic leaded packages come with an exclusive Positive Lock retention system that keeps chips secure during handling and shipping. Ceramic chip carrier sockets feature duplex plated contacts and snap-on covers that accommodate heat sinks. Both are available in standard and surface-mount versions.

AMP offers you more: high-speed, surface-mount sockets on .020″ centers. Gold-plated plastic carriers and sockets. For pin grid arrays, sockets in ZIF and LIF styles, plus custom VHSIC capability.

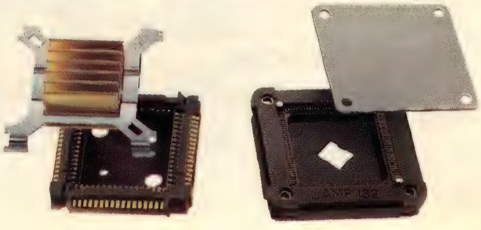
Choose your technology. AMP makes it easy to implement, with full socketing support.

Call (717) 780-4400 and ask for the AMP Sockets Desk.
AMP Incorporated, Harrisburg, PA 17105-3608.
CIRCLE NO 66

AMP Interconnecting ideas



Low-height sockets in all standard sizes (JEDEC A, B, D), with duplex-plated contacts for sure performance. High-speed, surface-mount sockets feature 0.5pF, 1.4nH contact characteristics.



LEADTIME INDEX

Percentage of respondents

ITEM	Off the shelf	1-5 weeks	6-10 weeks	11-20 weeks	21-30 weeks	Over 30 weeks	Average (weeks)	Last month's average (weeks)
TRANSFORMERS								
Toroidal	0	33	45	22	0	0	7.8	7.2
Pot-Core	0	11	67	22	0	0	9.1	9.2
Laminate (power)	0	33	50	17	0	0	7.3	8.6
CONNECTORS								
Military panel	11	11	22	56	0	0	10.9	6.0
Flat/Cable	14	50	22	14	0	0	5.0	4.2
Multipin circular	7	36	22	14	14	7	10.6	7.3
PC	22	11	45	22	0	0	7.3	5.4
RF/Coaxial	0	40	30	30	0	0	8.0	7.0
Socket	23	38	31	8	0	0	4.5	3.6
Terminal blocks	17	55	11	17	0	0	4.7	3.8
Edge card	14	50	29	7	0	0	4.4	4.3
Subminiature	43	14	43	0	0	0	3.7	8.0
Rack & panel	17	0	83	0	0	0	6.7	4.2
Power	20	40	20	20	0	0	5.6	3.3
PRINTED CIRCUIT BOARDS								
Single-sided	0	67	33	0	0	0	4.0	4.1
Double-sided	0	62	38	0	0	0	4.3	5.5
Multilayer	10	30	50	10	0	0	6.2	9.5
Prototype	0	87	13	0	0	0	2.8	3.9
RESISTORS								
Carbon film	43	33	24	0	0	0	2.6	3.6
Carbon composition	30	35	35	0	0	0	3.5	4.9
Metal film	36	41	23	0	0	0	2.6	6.5
Metal oxide	33	45	11	11	0	0	3.6	4.3
Wirewound	11	44	39	6	0	0	4.9	6.3
Potentiometers	14	43	29	14	0	0	5.4	6.5
Networks	25	50	19	6	0	0	3.5	6.2
FUSES	53	35	12	0	0	0	1.6	2.1
SWITCHES								
Pushbutton	38	23	39	0	0	0	3.5	4.5
Rotary	6	47	41	6	0	0	5.2	6.6
Rocker	33	22	45	0	0	0	4.0	6.5
Thumbwheel	20	30	40	10	0	0	5.4	7.8
Snap action	38	25	25	12	0	0	4.5	5.8
Momentary	34	33	33	0	0	0	3.3	5.0
Dual in-line	29	28	29	14	0	0	5.1	5.0
WIRE AND CABLE								
Coaxial	36	57	7	0	0	0	1.7	3.8
Flat ribbon	50	43	7	0	0	0	1.4	2.4
Multiconductor	30	50	20	0	0	0	2.6	4.7
Hookup	60	35	5	0	0	0	1.1	1.8
Wire wrap	57	29	14	0	0	0	1.7	2.6
Power cords	25	58	17	0	0	0	2.5	3.6
Other	0	33	67	0	0	0	6.0	6.4
POWER SUPPLIES								
Switching	0	30	60	10	0	0	7.0	8.6
Linear	9	18	64	9	0	0	6.9	6.5
CIRCUIT BREAKERS	15	15	47	23	0	0	7.7	6.0
HEAT SINKS	29	24	47	0	0	0	4.2	4.0

ITEM	Off the shelf	1-5 weeks	6-10 weeks	11-20 weeks	21-30 weeks	Over 30 weeks	Average (weeks)	Last month's average (weeks)
RELAYS								
General purpose	31	44	19	6	0	0	3.4	5.5
PC board	10	60	20	10	0	0	4.4	7.0
Dry reed	25	13	50	12	0	0	6.3	5.7
Mercury	17	17	50	16	0	0	7.0	6.5
Solid state	15	31	31	23	0	0	6.8	7.7
DISCRETE SEMICONDUCTORS								
Diode	26	35	29	10	0	0	4.6	4.6
Zener	35	21	35	9	0	0	4.6	5.7
Thyristor	36	21	29	14	0	0	5.0	6.3
Small signal transistor	38	6	44	12	0	0	5.6	6.3
FET, MOS	29	14	21	29	7	0	8.4	6.7
Power, bipolar	36	0	37	27	0	0	7.2	7.8
INTEGRATED CIRCUITS, DIGITAL								
CMOS	32	18	32	9	9	0	6.7	8.4
TTL	26	5	48	21	0	0	7.2	7.2
LS	33	11	17	39	0	0	7.8	6.8
INTEGRATED CIRCUITS, LINEAR								
Communication/Circuit	33	0	56	11	0	0	6.2	7.3
OP amplifier	19	14	38	29	0	0	7.9	6.6
Voltage regulator	26	11	42	21	0	0	6.9	6.0
MEMORY CIRCUITS								
RAM 16k	45	22	22	11	0	0	4.0	4.9
RAM 64k	50	30	10	10	0	0	3.0	4.3
RAM 256k	42	33	17	8	0	0	3.3	5.3
ROM/PROM	45	22	22	11	0	0	4.0	6.9
EPROM	40	20	20	20	0	0	5.2	6.2
EEPROM	45	0	33	22	0	0	6.2	8.0
DISPLAYS								
Panel meters	9	46	27	18	0	0	6.0	5.6
Fluorescent	40	0	20	40	0	0	8.0	7.0
Incandescent	43	0	43	14	0	0	5.7	3.4
LED	29	24	35	12	0	0	5.2	4.5
Liquid crystal	12	13	37	38	0	0	9.3	6.7
MICROPROCESSOR ICs								
8-bit	34	8	50	8	0	0	5.5	7.2
16-bit	30	0	50	20	0	0	7.2	8.4
FUNCTION PACKAGES								
Amplifier	14	29	43	14	0	0	6.3	5.3
Converter, analog to digital	0	27	40	33	0	0	9.1	6.2
Converter, digital to analog	0	25	50	25	0	0	8.5	6.2
LINE FILTERS	25	25	13	37	0	0	7.5	8.0
CAPACITORS								
Ceramic	30	30	35	5	0	0	4.2	4.9
Ceramic monolithic	29	43	21	7	0	0	3.7	4.7
Ceramic disc	27	33	33	0	7	0	5.1	5.6
Film	14	43	36	7	0	0	4.9	6.3
Electrolytic	18	41	35	6	0	0	4.6	6.1
Tantalum	11	33	34	22	0	0	6.9	7.3
INDUCTORS	0	50	50	0	0	0	5.0	6.7

Source: *Purchasing* magazine's electronic business survey

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MODEL BC200 SPECIFICATIONS

DIMENSIONS	**1.875″ x 5.75″ x 8″**
Input voltage	*22 to 32 V dc*
Outputs	*5 V, ±12 V; or 5 V, ±15 V*
Switching frequency	*100 kHz*
Efficiency	*60% minimum*
Ripple/noise	*100 mV peak-to-peak maximum*
Line regulation	*10 mV (22 to 32 V dc)*
Load regulation	*10 mV main (0.5% aux outputs)*
EMI	*Meets MIL-STD-461B*
Environment	*MIL-STD-810C, MIL-S-901C*
Input protection	*MIL-STD-704D*
Operating temperature range	*−55°C to +100°C*
Storage temperature range	*−65°C to +125°C*
MTBF (Ground benign)*	
Standard	*140,000 hours*
ER option	*1,100,000 hours*
MTBF (Air inhabited)*	
Standard	*23,000 hours*
ER option	*160,000 hours*

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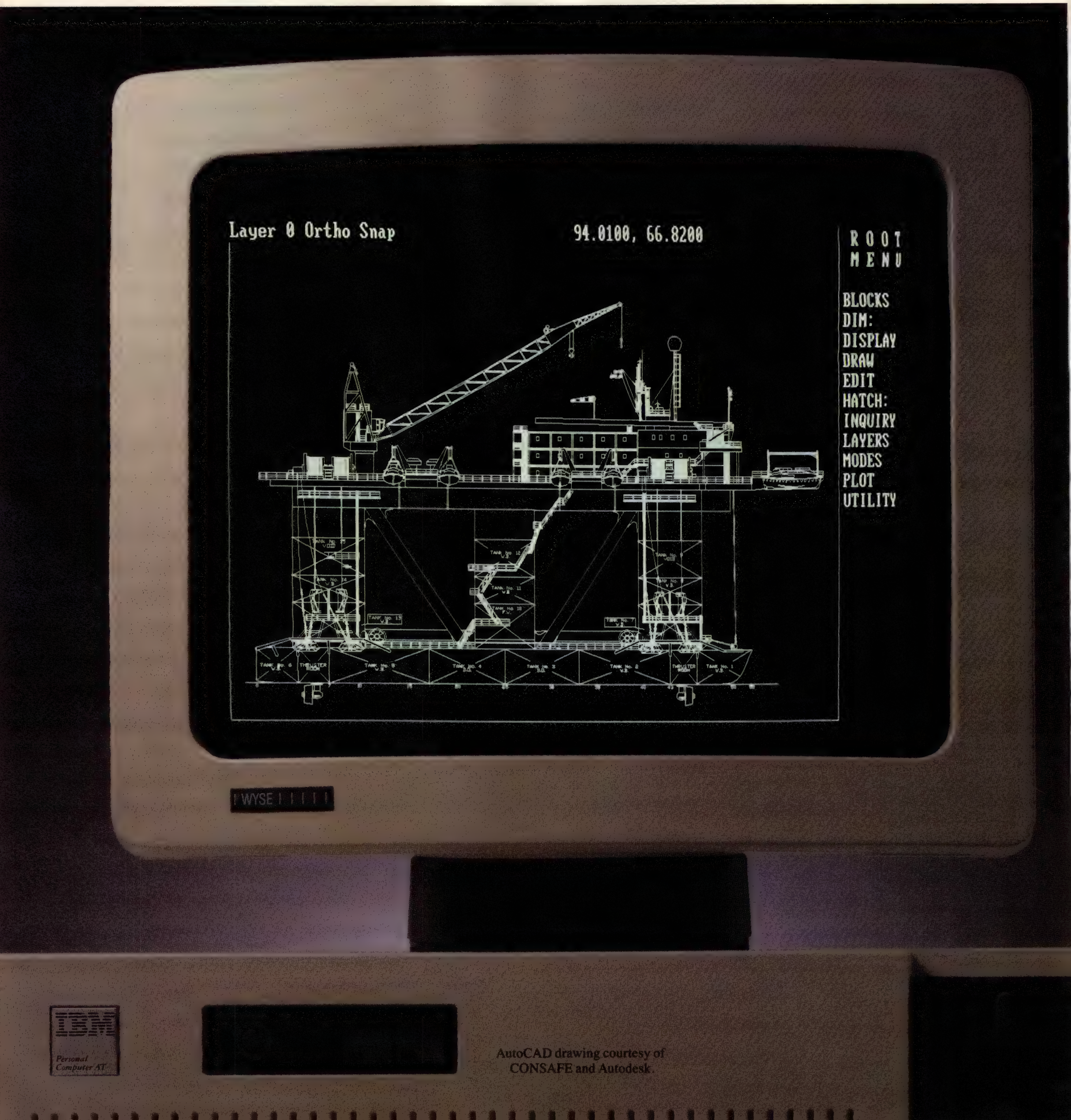

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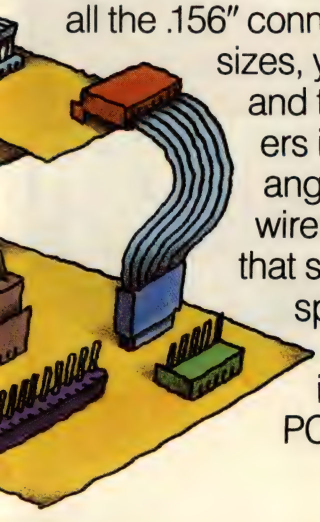

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CIRCLE NO 69

Semicustom-array directory

This year's semicustom arrays offer much higher density, more functions, improved performance, and greater reliability than did earlier arrays. Semicustom arrays are now suitable for portable systems, computers, memory systems, and automotive circuits.

David Smith, *Associate Editor*

Recently introduced semicustom arrays offer more on-chip logic, more LSI-level functions, and better performance than did arrays available a year ago. Although semicustom arrays have long been suitable for implementing random logic, they can now replace not only discrete random logic but also MSI and LSI chips in such demanding applications as portable systems, high-speed processors, video and memory subsystems, signal processors, automotive circuits, and industrial systems. In comparison with the standard products they replace, these semicustom arrays save pc-board real estate and power, offer more functions, improve performance, and increase reliability.

By far the most dramatic improvement in semicustom arrays is in gate density: Some CMOS arrays let you implement as many as 50,000 gates on one die (five times the number of gates that last year's arrays offered) so you can integrate much more of a system on an array than before.

The largest of these CMOS arrays, the LCA10129, has 129,042 equivalent 2-input gates. LSI Logic and Toshiba, which developed the array jointly, achieved such a large gate count by adding gates in the spaces otherwise reserved for wiring channels **(Fig 1)**.

The LCA10129 is the largest of a family of five channelless arrays, which the two companies unveiled in October 1985. LSI Logic calls the family the LCA10000 Compacted Array Series; Toshiba calls it the TC11SG Series. The arrays are fabricated in 1.5-μm technology. The smallest array in the series, the LCA10038, contains almost 40,000 gates, so it's about the same size as the largest channelless array from any other vendor.

The higher density that channelless arrays offer comes at the expense of lower gate utilization, however, because the wiring between gates on channelless arrays must run over other gates. Because a gate that's under a wiring channel is, in effect, part of the wiring channel itself, you can't use the gate for logic functions. LSI Logic, whose CAE design system assigns these wiring channels over the gates automatically, estimates that 40% of the gates are available for logic. In contrast, on conventional arrays having gate counts greater than 10,000, you can use between 70 and 90% of the gates, according to vendors of these arrays.

This year's conventional arrays also offer increased density, although they can't match the density afforded by the channelless arrays. In the past year, both NEC

***Semicustom arrays** are your gateway to higher levels of integration in products ranging from computers to cars. (Illustration courtesy Fairchild)*

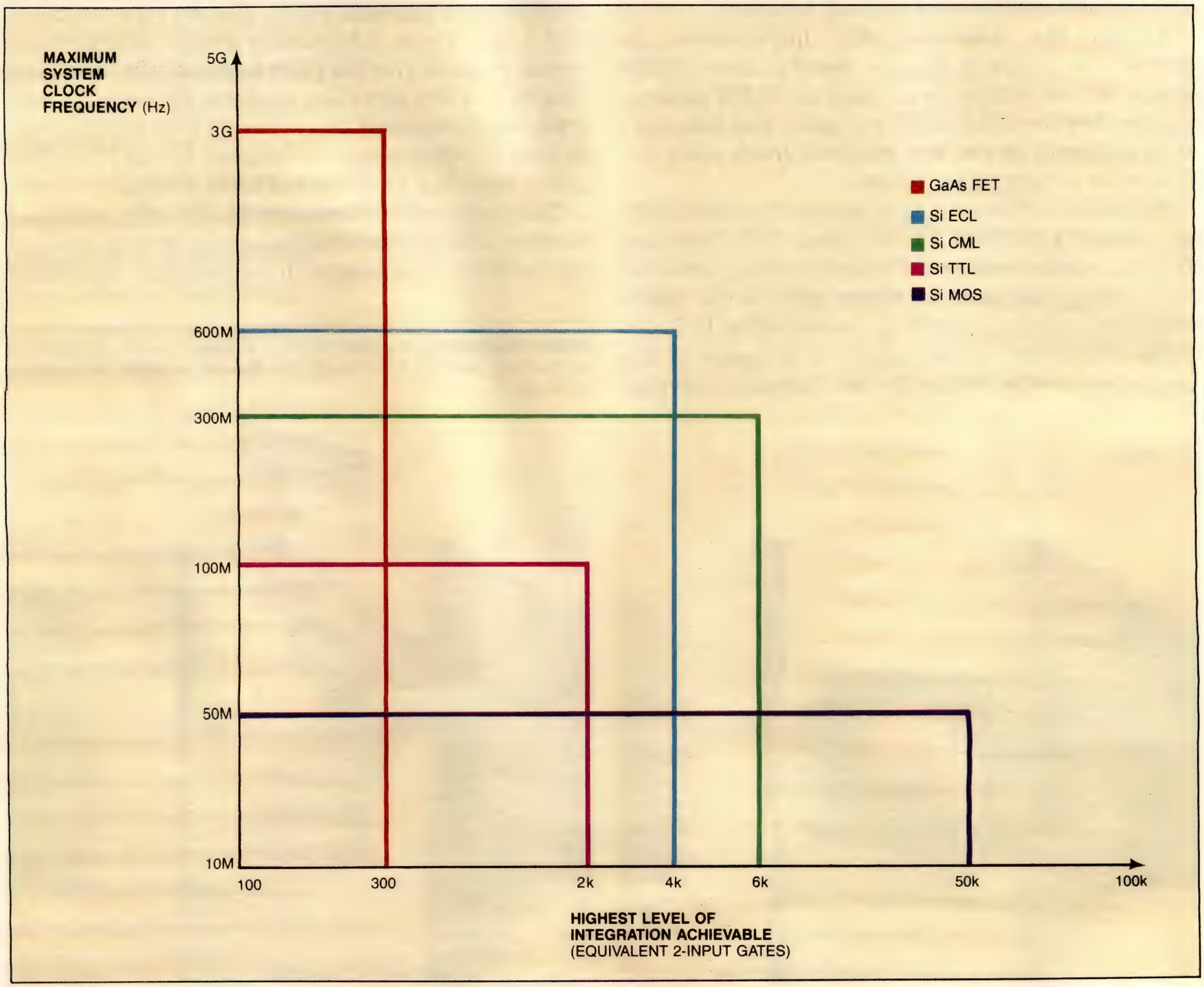
Recently introduced semicustom arrays let you implement as many as 50,000 gates on one die.

and Fujitsu introduced conventional (channeled) arrays having 20,000 gates. Like the channelless arrays, both companies' conventional arrays are fabricated in 1.5-μm technology.

Despite their lower gate utilization, however, channelless arrays offer more gates for logic implementation than do conventional arrays. The LCA10129, the largest channelless array, makes 51,617 (40% of 129,042) gates available for logic implementation; the largest conventional arrays make only 18,000 (90% of 20,000) gates available.

Because they're fabricated in 1.5-μm technology, the Compacted Arrays offer very short gate delays as well as high density. On the Compacted Arrays, the delay through a 2-input NAND gate (driving two loads) specs 0.7 nsec typ, which is as low as the delay for some ECL bipolar arrays. However, because CMOS devices furnish lower currents than bipolar devices do, CMOS arrays' performance is more susceptible to the loading of a system's interconnects, and therefore systems employing CMOS arrays will operate at lower speeds than will systems designed on ECL arrays having the same gate delay.

Another series of channelless arrays, the U Series



Circuits operating to 3 GHz or containing as many as 50,000 gates *are now possible on some semicustom arrays. Price and power constraints limit high-speed (GaAs and bipolar ECL) arrays to only hundreds or thousands of gates; low-speed, low-power CMOS technology, however, lets vendors put enough transistors on chip for 50,000-gate designs.*

from Hughes Aircraft (**Ref 1**), specs even lower gate delays than do the 1.5-μm arrays from LSI Logic. Although they're fabricated in 2-μm technology, the U Series arrays have gate delays of only 0.4 nsec, a spec as low as that for some ECL arrays. (However, because the ECL arrays have superior drive capabilities, systems using ECL arrays operate at much higher clock speeds than do systems using CMOS arrays.)

The largest product of this series, the HU1140, is larger than any array except the five Compacted Arrays; it contains 40,672 gates. The vendor estimates that you can use 60% (24,000) of the HU1140's gates for logic. The nine other arrays in the family range in complexity from 1040 to 32,120 equivalent 2-input gates. As with LSI's Compacted Arrays, Hughes's layout software assigns wiring channels where needed over gates on the array.

These large arrays do present problems, however. The major difficulty in putting a system on a big array is that most modern test equipment can accommodate a maximum of only 256 I/O pins. Driving a design with tens of thousands of gates from only 256 pins requires tens of thousands of test vectors. To keep test vectors and test time down while maintaining an acceptable level of test coverage, you'll have to design your system carefully for testability.

One way to design for testability is to buy your semicustom arrays from a company that offers macrocells that implement test circuitry. LSI Logic offers macrocells that include circuitry that you can use to implement scan-path test methods. These macrocells implement a form of scan-path design, which lets you serially inject a known state into the storage elements in the macrocells. With the scan-path design, you can initialize a circuit more easily than you could by running a large number of test patterns.

Even with these macrocells, test development and fault simulation can take as much time in your development schedule as logic design and simulation can. Furthermore, because of the I/O restriction that an integrated design places on the debugging of your system, putting a large array in the middle of your circuit board can make the board difficult to test.

LSI blocks integrate portable systems

Because LSI-level, on-chip building blocks provide predefined, predesigned functions (processing and memory elements, for instance), they reduce your design time; because the vendor can supply test vectors for them, they reduce your test-development time. In

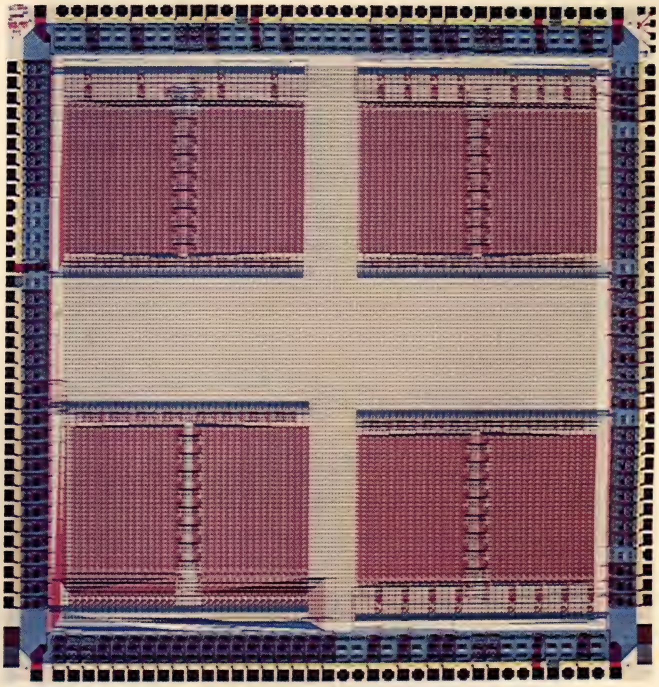
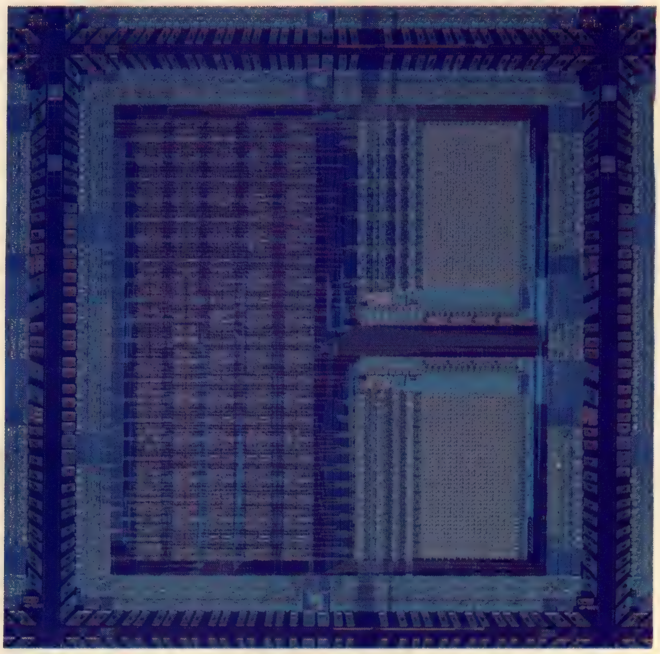


***Fig 1—To pack 129,042 gates onto one IC** (the LCA10129), designers at LSI Logic and Toshiba removed the dedicated routing channels and covered the surface of the chip with gates. This type of array, which the two companies developed jointly, can integrate designs having as many as 50,000 gates.*



***ECL arrays with on-chip RAM,** such as the QM1600S from AMCC, can implement video and memory subsystems. The QM1600S's RAM specs 6-nsec access time and 1280 bits of memory.*

On-chip LSI-level circuits let you design a 32-bit processor with an integral 64k-bit ROM on one CMOS array.

addition, these LSI-level circuits are crucial for making some special functions possible at all—you need them, for example, to integrate kilobit memory blocks on an array. LSI-level blocks are always more expensive on an array than they are as discrete parts, however, so you'll want to use them only in applications where space or clock-frequency requirements justify the expense.

The most common LSI-level circuits on arrays are memory blocks. Fujitsu has two lines of array products that have varying sizes of RAM and ROM. The AVM Series includes as much as 4k bits of ROM, 2k bits of RAM, and between 1k and 4k logic gates on a single die. The company's recently announced UHM Series offers six times the memory capacity and four times the number of logic gates of the AVM Series. Because it has as much as 24k bits of ROM and 12k bits of RAM, the UHM Series can implement a useful amount of microcode and temporary storage memory on one chip.

Instead of loading programs into RAM, as do conventional computers, portable systems often carry programs in onboard ROM, saving RAM for working space. A number of semicustom arrays now have onboard ROM. One such array, the LSA2006 Structured Array from LSI Logic, contains 64k bits of ROM, enough for several applications routines or for an operating system.

Other LSA2000 Series arrays contain LSI-level blocks such as multiplier/accumulators and ALUs in addition to memory. Two of these arrays have ALUs that are similar in operation to the 2901 Series bit-slice processors. Another of these arrays integrates a general-purpose ALU with 2.25k bits of RAM and 3000 logic

Vendors offer more customer support

Semicustom array vendors are providing more customer support—such as workstation support, training, CAE software availability, and design centers —than they made available last year **(Ref 1)**. For example, semicustom-array vendors have made noticeable efforts to support popular engineering workstations. As a result, you can create net lists for a variety of arrays on any one workstation, and you can even complete the physical design of some arrays on the same workstation. For gate-array design, many libraries are available on the workstations from Mentor Graphics (Beaverton, OR) and Daisy Systems (Sunnyvale, CA). A number of semicustom-array vendors now also support workstations based on the IBM PC.

Although most designers don't currently perform physical design themselves, more designers will begin to perform this process in the future. On workstations from Mentor Graphics, you can now perform the entire design process—from schematic capture to physical design and PG-tape generation—for Gould/AMI gate arrays. Later this year, Motorola and NCR will offer design libraries that let you both design and lay out arrays on the Mentor Graphics machines. The Motorola and NCR CMOS arrays are jointly supported by the two companies. Libraries for other arrays, such as jointly supported CMOS arrays from Fairchild and VTI, are currently available for logic design on these workstations.

Vendors offer free libraries

To encourage customers to use their products, some semicustom-array vendors are reducing or eliminating the fee for their libraries. To qualified users, Fujistu offers free libraries for its gate-array families on workstations from Daisy Systems, Mentor Graphics, and Valid Logic (San Jose, CA). (A qualified user is one who has agreed to develop a chip with the company.) A free library can save you thousands of dollars in engineering costs.

For designers using the IBM PC, General Electric supports the cell library for its IGC20,000 Series 2-μm gate arrays on P-Cad (Los Gatos, CA) CAE systems. With GE's libraries, the P-Cad system can offer an IC-vendor-supported design system for accurately designing and simulating array designs. The system does not perform layout, however; you transfer a net list and simulation vectors to GE.

IC vendors supply software

Instead of merely supplying cell libraries for CAE systems on workstations, some companies are bringing their own design systems up on these workstations. International Microcircuits Inc offers its Easygate software for Daisy and gates. You can choose from three Structured Arrays that have one or two 16×16-bit multiplier/accumulators on chip. Besides designing and testing these cells, the company supplies test circuitry and test vectors for verification of the completed IC.

Another boon for portable-system designers is the fact that many of these arrays—whether they're CMOS digital, bipolar digital, or linear arrays—operate at voltage levels below the 5V standard. Many arrays can operate at 3.3V, which is emerging as the standard for low-voltage systems. In fact, for battery-powered systems, some vendors offer arrays that can operate with supply voltages below 3.3V. For example, Ferranti Interdesign's Digilin arrays operate with supply voltages as low as 1V.

Remember, however, that circuits that use lower supply voltages experience both increased gate delays and decreased noise margins. When you consider a low-voltage design for an array, you should contact the array vendor to determine how it derates the performance of its array with sub-5V supplies.

For a portable application that must use a 5V supply, you can use arrays that offer low power consumption. Array manufacturers can lower the parts' power consumption by using certain techniques during fabrication. Cherry Semiconductor, for example, uses ion-implantation techniques to create a total of more than 5 MΩ of resistance on its 3100 Series arrays. This level is two to three times the amount of resistance found on a typical linear array. Because the extra resistance reduces current levels, you can use it to design low-power bipolar circuits.

Mentor machines. VTI has made its complete IC-design suite available on Hewlett-Packard (Palo Alto, CA) workstations. LSI Logic supports its LDS III CAE on Sun (Mountain View, CA) workstations running Unix. You use these software packages to create net lists and test patterns.

Some array houses are even exchanging software, both to make the design process easier and to make their CAE software compatible with that of other companies. LSI Logic's LDS software can be found at a number of semicustom-array houses, including Texas Instruments and AMD. Similarly, through a major development agreement, NCR and Motorola will combine the software used to design NCR's standard-cell ICs and Motorola's gate arrays. Both companies will offer both types of products, so you can travel to either company, use the same software to develop an array, and have either company fabricate your design.

Unfortunately, the most direct effort to unify the wide variety of CAE software, the EDIF standard, has not yet been widely implemented by semicustom-IC vendors. EDIF version 1.0, which promises to create a common vehicle for transporting gate-array design information, has been published, but vendors are slow to create ports from their design systems to the proposed standard. Only Motorola has made the commitment to introduce EDIF software for workstations in 1986.

Finally, vendors are gradually beginning to offer their customers more training and design support than they offered last year. Most companies already offer some form of training, and some are making their training more accessible. For example, Gould/AMI sponsors free seminars on designing semicustom arrays on workstations. Control Data (Minneapolis, MN), which offers IC-design tools but doesn't sell its own gate arrays, has opened a center where engineers can learn many facets of IC design, including how to design and implement gate arrays.

To bring design support to companies that aren't near proprietary design centers, some semicustom-array vendors give third-party design houses access to their products and design tools. General Electric, for example, has signed agreements with three design houses: Advanced Logic Solutions (Portland, OR), Owl Electronic Laboratories (Old Saybrook, CT), and Texas Arrays Inc (Carrollton, TX). Hitachi has made a similar agreement with Diplomat Electronics (Melville, NY).

Reference

1. Smith, David, "EDN Semicustom-IC Directory, Part 5—Customer Support," *EDN*, February 21, 1985, pg 193.

This year's conventional arrays also offer increased density, although they can't match the density afforded by channelless arrays.

Because of their on-chip RAM and high gate density, recently developed arrays can implement computer circuits that arrays couldn't implement before. High-speed (>200-MHz) arrays now include as many as 5000 gates, 1280 bits of RAM, and the capability to implement gigahertz circuitry. Processors implemented with these arrays can attain higher integration levels and clock frequencies.

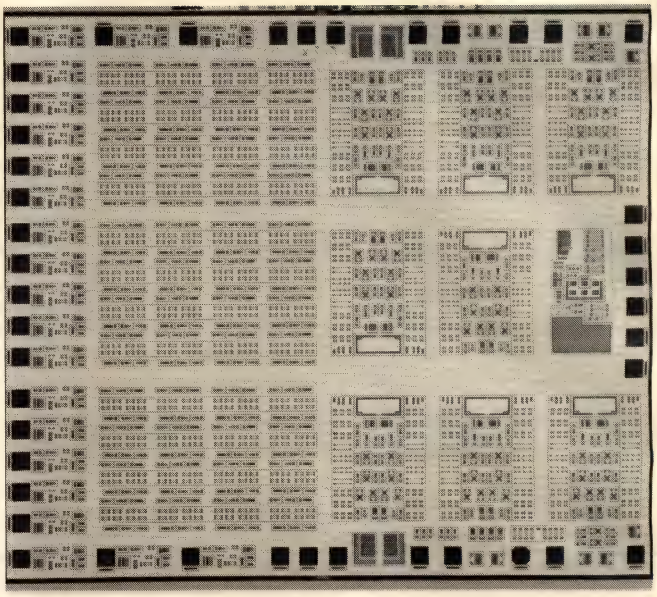
The Am3500 family of ECL gate arrays from Advanced Micro Devices, for example, offers the highest level of integration available for an ECL array. It comprises three products: the Am3500B standard 4988-gate array, the Am3550 5228-gate array with TTL and ECL I/O circuitry, and the Am3525 3500-gate array with an onboard, 1152-bit RAM. All the arrays offer three speed/power options for each gate; the fastest array specs 0.6-nsec worst-case switching time. In addition to 5000 gates, the Am3500B and Am3550 include as many as 134 and 124 I/O cells, respectively. You can configure each of the I/O cells on the Am3550 to operate with pseudo-ECL (5V reference), true-ECL (−5.2 and 5V reference), or TTL signals. The true-ECL cells can also operate from −4.5 and 5V voltage supplies.

GaAs arrays, which manufacturers introduced in 1985, raised the maximum clock frequency for semicustom arrays from 600 MHz to 3 GHz. Honeywell, Harris, and Triquint now offer GaAs arrays that have hundreds of logic gates. These new arrays are several times more expensive than ECL arrays, however, and they cause transmission-line effects that complicate board-level design, so they're suitable only for high-priced applications (such as military ones) requiring the highest performance **(Ref 2)**.

Build video and memory subsystems

Arrays that combine ECL circuitry with on-chip RAM are also useful for building video and memory subsystems. Because on-chip ECL RAMs have access times as low as 5.5 nsec typ, they can function as very-high-speed caches and video-data buffers. For example, to buffer a video signal for a 1024×1024-pixel image that refreshes at 30 Hz—a typical spec for high-resolution monitors—you need approximately 32M bps of video data per bit of resolution. A 5.5-nsec RAM could, therefore, read out video data at speeds approaching 100M bps, which would be more than enough bandwidth to buffer the video data.

In particular, you can implement scratchpad memories, caches, video processors, and video buffers on arrays. Alternatively, you can use the linear/digital arrays for A/D and D/A circuits, or you can use arrays as an interface between high-speed ECL processing and standard TTL I/O signals.



Linear and digital macrocells *make it easy for you to develop linear/digital circuits on the FB330 Series arrays from Micro Linear. The library of macrocells includes op amps, video amps, oscillators, and timers.*

Both Advanced Micro Devices (AMD) and Applied Micro Circuits Corp (AMCC) offer ECL arrays with on-chip RAM. Both arrays spec about 1200 bits of RAM and 6-nsec access times, but the AMD Am3525 has 3500 logic gates; the AMCC QM1600S has 1600 gates. When on-chip circuitry accesses the RAMs, they operate faster than do standard ECL RAMs. Off-chip memory access is somewhat slower, depending on the I/O circuitry you design; even so, these arrays can match the performance of most discrete-component implementations.

For memory systems that don't need the fast access time of ECL arrays, you can use CMOS arrays that have memory (such as the Fujitsu and LSI Logic CMOS arrays). These arrays offer more memory than the ECL arrays, and they're suitable as look-up tables in video systems and as register files in microcomputers.

Linear/digital arrays are suitable for implementing the interface between the digital (data-input) and analog (CRT drivers) sections of video circuits. Not only can you implement data-conversion circuits on these arrays, but you can take advantage of the arrays' predefined macrocells, which simplify and speed the

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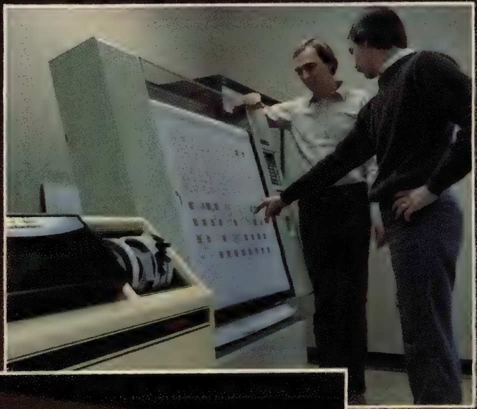

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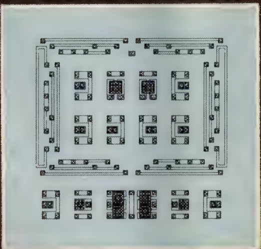

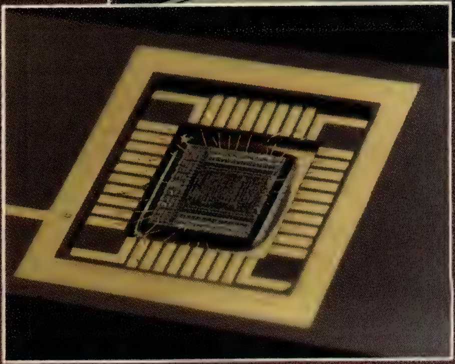

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A typical prototype turnaround time is six weeks, from receipt of CAD layout tape.
The inherent symmetry of the MODULA Series allows subcircuit modules to be placed with various orientations on the array, allowing greater flexibility in their placement and interconnection. With these subcircuits in place, their interconnection pattern can be stored in a CAD workstation and used in subsequent designs.

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CIRCLE NO 70

One way to design for testability is to buy your semicustom arrays from a company that offers macrocells that implement test circuitry.

design of your circuit.

Arrays that have LSI-level cells on chip—LSI Logic's Structured Arrays, for example—are useful in signal-processing applications. The high levels of integration on these semicustom arrays let you integrate more digital-signal-processing functions on a single IC. Furthermore, because these arrays include processing cells, you don't have to design those cells in discrete gates. Not only is your IC-design process simpler, but the circuits operate at higher speeds, because they're more dense than random gates.

The LSA2008 Structured Array, for example, has two 16×16-bit multiplier/accumulators and 5000 logic gates. You can use the multiplier/accumulators to construct fast Fourier transform circuits, taking advantage of their separate accumulate paths. For on-chip data and signal processing, you can use the LSA2011, which includes one 16×16-bit multiplier/accumulator, four 4-bit-slice ALUs, and 5000 logic gates. This array can implement a 16-bit processor that can control digital-signal processing through the multiplier/accumulator. Similarly, the array can form the basis for a general-purpose CPU.

Semicustom arrays can also implement filters, amplifiers, and A/D and D/A converters that are useful in analog signal-processing applications, such as telecommunications. For instance, CMOS linear arrays like the W Series arrays from Exar can implement switched-capacitor circuits to create filters and other linear circuits. Switched-capacitor circuits are generally easier to design, particularly in CMOS, than their purely linear counterparts. However, the frequency response of switched-capacitor circuits is limited to a fraction of their clock frequency, so these circuits can handle only signals whose frequency range is less than 1 MHz.

Because many circuits can't operate under such limitations, however, bipolar linear arrays are more widely used than CMOS linear arrays in analog signal processing. Some bipolar linear arrays, for instance, can operate at frequencies in the hundreds of megahertz, a capability that's necessary in high-speed data-processing circuits, such as fiber-optic transceivers. Two such arrays, members of Tektronix's Quickchip family, have npn transistors that spec f_T at 6.5 GHz with a collector current of 12 mA.

Some of these arrays also provide predesigned cells, that is, organized patterns of components upon which vendor-designed macros fit. You can design with these macros as you would with components, simulating them with Spice models provided by the vendor. Arrays that support macros need more generic component specifications, so none of them can offer the 6.5-GHz performance of the Tektronix arrays. Still, arrays with predesigned cells have f_T specs as high as 1 GHz, so they're useful in less-demanding communications applications.

Among the macros that semicustom-array vendors provide are bandgap voltage references, bandgap regulators, operational amplifiers, buffers, and comparators. Each macrocell on Raytheon's RLA120 array can implement one of three types of op amps—4558, 324, or 3403—or one of two types of comparators—339 or 365. For its Macrochip Series arrays, Ferranti Interdesign also offers transconductance amplifiers and S/H cir-

EDN's semicustom-IC tables

Following this article are three product tables (pg 112) and a section describing semicustom-array manufacturers (pg 127). Each of the three product tables—MOS digital arrays (including GaAs ICs), bipolar digital arrays, and linear/digital arrays—has three subdivisions: Capacity, Performance, and General Information. You can use these tables to determine whether a product line meets your application's integration and performance requirements.

However, the actual performance of your design on an array depends on the macrocells you use and the physical layout that results from your design. Therefore, you'll still need to work with a vendor to get a firm estimate of how your circuit will perform on a particular array.

In the section on semicustom-array manufacturers, you'll find information on workstation support, design responsibilities, macrocell libraries, and production schedules and requirements. The following simulation parameters appear in the descriptions in macrocell libraries: intrinsic delays (ID), load-dependent delays (LD), set-up-and-hold parameters (SUH), temperature sensitivities (TS), voltage sensitivities (VS), power dissipation (PS), fan-in (FI), and fan-out (FO).

Because the cost of a semicustom IC depends on the complexity and volume of the application, the section doesn't list prices. Instead, it lists (under "Inputs for Cost Estimation") the criteria that each vendor requires to give you a cost estimate.

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CIRCLE NO 71

The largest channelless array makes 51,617 gates available for logic implementation; the largest conventional arrays make only 18,000 gates available.

cuits. When you use the FB330 arrays from Micro Linear, you can take advantage of macros that implement video amplifiers, a modulator/demodulator like the LM1496, triangle oscillators, and timers. These macros can make designing array-based communications circuits similar to designing with standard parts.

Hardy arrays drive automotive circuits

Semicustom arrays also find application in automotive circuits, which are sometimes more demanding than even military applications. Not only must automotive ICs operate over extreme temperature ranges, but they must operate normally at 12V and sustain transient surges to greater voltages. To monitor the operating conditions of an automobile, these arrays must have both on-chip analog circuitry and the ability to convert analog signal levels to digital signals for control by a central processor.

The BC3G Series linear/digital arrays from Barvon Research can handle many of the extremes of automotive electronics. Arrays in this series can operate over temperatures ranging from −55 to +125°C and with power and signal levels as high as 40V. The company's BiCMOS technology (which combines bipolar and MOS transistors on one chip) gives the arrays' linear circuits the accuracy of bipolar transistors while making the digital circuits easier to design.

A BC3G array contains between 585 and 1149 linear components and 250 to 400 equivalent 2-input logic gates. Its digital gates supply some control logic, which could, for example, control a car's taillight assembly. The array's eight to 11 npn transistors, which can drive more than 100 mA, can control other automobile electronics. The array includes as much as 1.32 MΩ of resistance in diffused resistors, and it has a programmable capacitor for which you can specify values of 10 to 50 pF.

For developing prototypes for automotive applica-

Every house an array house

A novel service from LSI Logic Corp lets you not only create your proprietary logic designs on arrays, but create your own arrays for your systems. LSI Logic's Composable Arrays can include your choice of LSI-level standard cells, metal-configurable RAM and ROM, standard cells, and gate-array cells. You specify the types of circuits on the base array, and the vendor creates a custom array that you use to implement different designs including those circuits. In essence, you create your own gate arrays and then implement your designs on them.

For example, assume your company is developing a series of processors that all use the same type of caching scheme. The processors all use the same amount of memory, but the interface and control logic for each processor is different. You could design a Composable Array that contained the proper amount of memory and logic for implementing any of the processor's caches and then have LSI Logic prepare base wafers. Then you could design a variety of cache chips on the base wafers, taking advantage of both the bulk manufacturing possible with base wafers and the fast turnaround time possible with individual caches.

This service represents one of the next steps in vendor-customer relationships in the semicustom-array industry. Not only do you interconnect the circuits on the Composable Array, but you define what types of circuits you have to work with. Because Composable Arrays let you define the types of on-chip functions they'll have, your arrays are more like fully custom ICs than gate arrays. Still, once you've defined the base array and LSI Logic has fabricated it, you can take advantage of the quick turnaround time and low development costs that gate arrays offer.

By amortizing the cost of the development of the base array across several final implementations, you'll spend less money than you would if you used fully custom techniques. Even though Composable Arrays are less expensive, they let you design every layer of your array, much as you could with a fully custom implementation. Although this service wouldn't suit smaller companies that don't develop lines of similar products, it could give larger companies a valuable advantage in array development.

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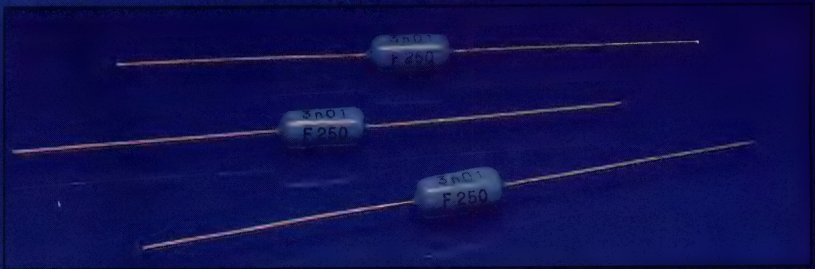

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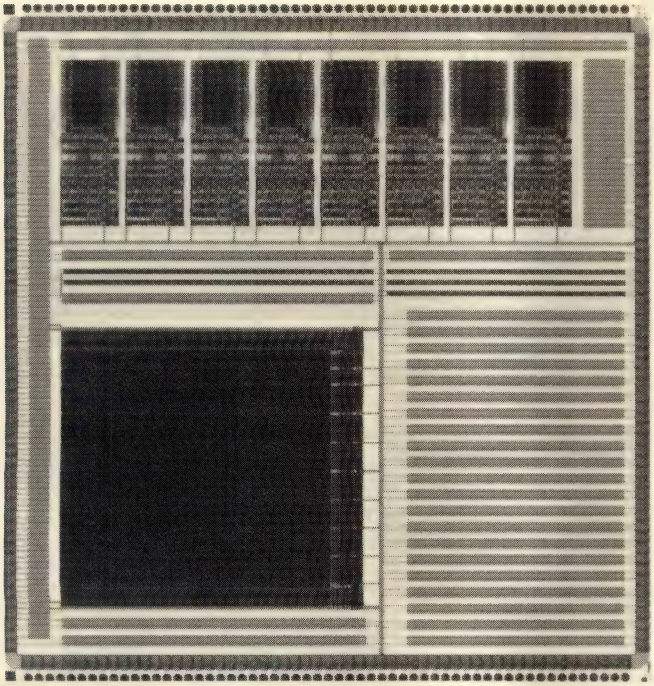
CIRCLE NO 72

Some high-speed (>200-MHz) arrays now include as many as 5000 gates and 1280 bits of RAM; you can use them to implement gigahertz circuitry.



***Its 64k bits of on-chip ROM** allow the LSA2006 Structured Array from LSI Logic Corp to store an operating system or several applications programs next to a user-designed CPU. Eight 2901-equivalent circuit blocks and 4300 logic gates let you design a self-contained processor.*

tions, Ferranti Interdesign supplies kit parts—ICs whose components are connected to pins. You can use the components in a breadboard to make a prototype of your design. The kit parts' specs are identical to the companies' MO Series linear arrays (Monochips). The kit parts include npn and pnp transistors in addition to diffused resistors that vary between 200 and 100 kΩ.

The Monochips' 20V breakdown voltage lets them implement linear designs that operate at 12V levels. For more demanding circuits, one array in the series, the MOD, can operate at voltages as high as 36V. Ferranti Interdesign specs these arrays over −55 to +125°C, so they're suitable for automotive applications.

High-voltage ICs suit industrial uses

Arrays with both linear and digital circuitry, such as the BC3G Series from Barvon, are particularly useful in industrial-control applications. Such arrays let you create linear/digital interfaces with some degree of customized control circuitry on chip. Because of the wide variety of A/D converters on the market, putting data-conversion circuitry on arrays may not be economical in many control systems. However, because they integrate control and conversion circuitry, the arrays can use less power and space than multichip implementations use.

Many industrial applications also require arrays having a large voltage range. Arrays in such systems must have a large signal-voltage capacity so that you can connect them to sensors and measuring equipment, thereby integrating the control-system interface. Industrial ICs must usually spec an operating-temperature range of −40 to +85°C, so you can use arrays suitable for automotive applications in industrial systems.

The Genesis 3500 from Cherry Semiconductor, a linear array with a photodiode on chip, is suitable for sensors in industrial applications. The company houses the array in a transparent epoxy package. The 3500 has 59 small-signal npn, two power npn, and 24 small-signal pnp transistors, as well as 214 resistors. The power npn transistors can operate at currents as high as 300 mA, so the array can drive high-current industrial-control components, such as relays.

All the linear arrays in Cherry's Genesis Series can operate at 20V and over the military temperature range, making them suitable for most industrial, and many automotive, applications. Some members of the series offer an extended-performance option that gives you npn transistors capable of operating at 400 mA (without the option, the arrays have 200-mA power transistors). The company can also put two chips in one package, so you could, for example, combine an array with a discrete power device, a temperature-sensitive IC, or an LED in a single package. **EDN**

References

1. Smith, David, "Semicustom ICs for military use meet rigid reliability specs," *EDN*, January 23, 1986, pg 59.
2. Smith, David, "Gallium arsenide challenges silicon in high-speed-array applications," *EDN*, June 27, 1985, pg 75.
3. Smith, David, "Standard-cell ICs and gate arrays integrate memory systems on chip," *EDN*, October 3, 1985, pg 59.
4. Beresford, Roderick, "A profile of current applications of gate arrays and standard-cell ICs," *VLSI System Design*, September 1985, pg 62.

Article Interest Quotient (Circle One)
High 470 Medium 471 Low 472

STANDARDS UPDATE

FCC TELECOM RULES, PART 68

Clarification of the 2nd, 3rd and 4th Report and Order (Docket 81-216) was offered by Mr. Bill Von Alven of the FCC to attendees of the EIA/ITG Conference in Washington, DC. The November conference attracted over 150 persons from the telephone and related industries to a series of specialized talks and demonstrations focussed on telephone interconnect issues.

The 2nd Report and Order now allows the connection of digital Network Channel Terminating Equipment to the network, while at the same time requiring testing and registration as with analog devices.

The 3rd Report and Order cleared up a number of rules and most particularly changed the signal power and on-hook resistance limits under Part 68. The 4th Report and Order offered clarification on the standards for alarm dialers.

The premier public demonstration of a specialized Part 68 Workstation™ from Compliance Design Incorporated also highlighted the EIA/ITG. Attendees saw demonstrations of a single rack setup that incorporates all the equipment necessary to test to the electrical specification of Part 68.

The Workstation tests include: (1) hazardous voltages and currents, (2) signal power limitations, (3) balance, (4) impedance limitations, (5) billing protection, and (6) surge. By putting all this technology together in a single unit, Compliance Design has made testing to the Part 68 specification simpler and easier than with jury-rigged collections of equipment now used in many locations. Cost of the Part 68 Workstation is $49,950 (FOB Boxborough, MA) and includes complete documentation plus one full day of training. Circle the Compliance Design Reader Service Number below for more information.

FCC EMISSIONS RULES — COMPUTERS, PERIPHERALS, AND ELECTRONIC EQUIPMENT, PART 15

A complaint from Keytronics to the Federal Communications Commission has caused government action against a foreign manufacturer. Five retail outlets have been cited for handling Model 5151 keyboards made by the Taiwanese firm Behavior Communications. Keytronics complained that the keyboards did not have the proper FCC authorization and that Behavior Communications therefore had an unfair trade advantage.

As budgets are trimmed in Washington, investigation and enforcement rely more and more heavily upon tips and complaints like this. The Commission's resources are better spent in handling actual non-compliance cases than in routine cataloguing and rulemaking.

And attacking a manufacturer's or importer's distribution chain is one of the most effective remedies the Commission has in interdicting illegal equipment. Retailers, distributors, and even lessees and owners are liable for compliance with such regulations as FCC Part 15. Fines and possible imprisonment are effective deterrents to the sale of non-complying devices. There are several recent cases in which the FCC attacked distribution channels in an effort to stop the sale of non-complying devices.

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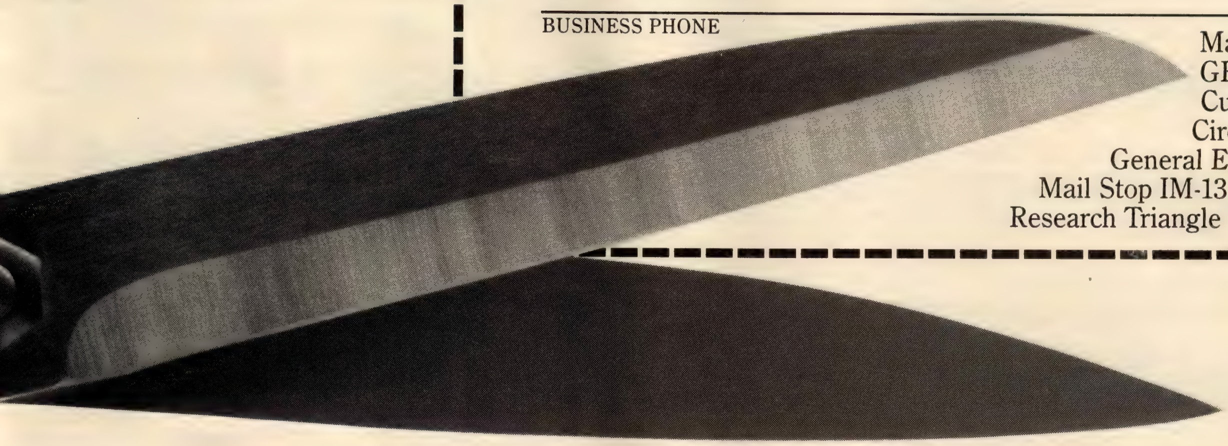

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						INTERNAL GATE DELAYS WITH 2 LOADS, 1 mm METAL (nSEC)		OUTPUT-BUFFER DELAYS WITH 50-pF LOAD (nSEC)		
MANUFACTURER	PRODUCT LINE	DRAWN TRANSISTOR CHANNEL LENGTH (μm)	NUMBER OF EQUIVALENT 2-INPUT GATES	TYPICAL GATE UTILIZATION (%)	NUMBER OF BONDING PADS (DEDICATED POWER)	TYP	MAX	TYP	MAX	MAXIMUM FLIP-FLOP TOGGLE FREQUENCY (MHz)
AMCC	Q6000	2	1394 TO 6206	85	74 TO 154 (4 TO 16)	1.3	—	8.2	—	50
	Q6000A	1.8	1395 TO 6206	85	74 TO 154 (4 TO 16)	1.0	—	6.4	—	50
AMD	7000	2	2000 TO 10,000	70 TO 95	232 MAX	1.4	2.4	5.7	9.7	50 TO 70
ARRAY TECHNOLOGY	DHS, HDC*	3	300 TO 2650	80	36 TO 94	1.4	3.2	6	—	35
BARVON RESEARCH	BC2XX	2	100 TO 10,000	—	20 TO 180 (2 TO 4)	1.6	1.8	10	15	75
	BC4XX	4	500 TO 5000	—	43 TO 93 (2)	2.5	5	18	25	55
	BC5XX	5	500 TO 5000	—	43 TO 93 (2)	3.5	6.5	25	35	45
CALIFORNIA DEVICES	DLM	3	200 TO 10,152	70 TO 95	30 TO 156	2	3.8	6	11.8	40
	CHA	2	210 TO 13,230	75 TO 95	30 TO 176	1.1	2.1	5.3	9.9	80
CIRCUIT TECHNOLOGY	MA8304	3	392	90	28 (2)	3	5	20	25	35
	MA2000	4	1120 TO 6864	90	48 TO 136*	4	6	20	25	25
	MA3000	3	1120 TO 6864	90	48 TO 136*	3	5	20	25	35
CUSTOM MOS ARRAYS	C2000	2.5	200 TO 3100	75 TO 95	40 TO 149	2	3	7	12	50
	C3000	1.9	1500 TO 10,500	70 TO 85	72 TO 240 (8)	1.1	1.9	5	9	90
	C5000	1.25	500 TO 25,000	70 TO 80	70 TO 280 (4 TO 24)	0.5	0.9	3.5	5	350
CUSTOM SILICON	HCA6200	2	2430 TO 4860	80 TO 95	100 TO 124 (12 TO 16)	1.9	—	5.6	10.3	85
	HCA6300	3	648 TO 2295	80 TO 95	40 TO 124 (2 TO 12)	2.5	—	8.2	15.6	70
ELECTRONIC TECHNOLOGY	D3S, D3D, D5S	3, 5	300 TO 4000	70 TO 95%	40 TO 120 (0 TO 4)	2.3	6.9	10	30	25
EXAR	XR-30,000	3	156 TO 3025	80 TO 90	22 TO 98 (2)	3	6	15	—	35
FAIRCHILD	FGC	2	540 TO 8300	90	44 TO 208 (4 TO 16)	0.9	1.7	4	8	210
FERRANTI/INTERDESIGN	MH	5	70 TO 1600	90	18 TO 84	8	14	30	50	50
	MC	7*	140 TO 800	90	32 TO 68	8, 20*	12, 25*	50	75	20
FUJITSU	AVB	1.8	357 TO 2052	80 TO 90	38 TO 80 (4 TO 8)	1.4	2.05	3.9	5.8	85
	AVM	1.8	1024 TO 4096	80 TO 90	110 TO 120 (4 TO 8)	1.4	2.05	3.9	5.8	85
	AV	1.8	2640 TO 8000	80 TO 90	106 TO 160 (4 TO 12)	1.4	2.05	3.9	5.8	85
	H	2.8	440 TO 3900	>90	***	2.8	3.9	8	11.2	60
	VH	2.3	2600 TO 8000	>90	***	1.8	2.5	4.8	6.7	74
	UH	1.5	4000 TO 20,160	>90	220 (14)	1	1.45	3.5	5	120
	UHM	1.5	4000 TO 15,000	>90	219 (24)	1	1.45	3.5	5	120
GENERAL ELECTRIC	IGC20,000	2	300 TO 13,500	80	44 TO 200	1.7	2.3	6	9	50
GENERAL INSTRUMENT	LA	5	560 TO 1440	—	38 TO 62 (2)	3.5	—	40	55	12
	UA	3	560 TO 1440	—	38 TO 62 (2)	2	—	20	35	16
GOULD AMI SEMICONDUCTOR	GB	2	1000 TO 10,000	95 TO 99	68 TO 208 (8 TO 16)	1.5	2.8	3	6	50
GTE	G5	4	504 TO 2024	—	42 TO 80 (2)	2.2	2.8	10.0	13	20
HARRIS SEMICONDUCTOR	HGA-C	3	648 TO 2520	—	54 TO 100 (4)	3	5	7	10	75
HOLT	HI-5	4	240 TO 2185	—	40 TO 76 (4)	5	8	20	—	30*
	HI-3	6**	153 TO 1020	—	44 TO 68	15***	—	—	—	4.8***
HONEYWELL	HC3500R	1.8	3854	80 TO 85	112 (4)	2.4	8.2	4	10	30
	HC20,000	1.25	20,000	80 TO 90	284 (40)	0.8	1.7	7.9	15.7	100
HUGHES AIRCRAFT	U*	2	1040 TO 40,672	50*	48 TO 256 (8)	0.7	1.2	2.5	3	>200
	V	2	1500 TO 9750	80 TO 90	72 TO 180	1.2	1.4	4.5	5	70
	H	3	1500 TO 9750	80 TO 90	72 TO 180	1.8	2	4.5	5	45
INTEGRATED CIRCUIT SYSTEMS	DHS	3	300 TO 1800	—	42 TO 104 (2 TO 4)	3	—	15	—	30
INTEGRATED LOGIC SYSTEMS	CB-3000	3	800 TO 7300	85 TO 95	44 TO 174	2.5	5	6	11	75
	CA-2000	2	1100 TO 15,000	85 TO 95	44 TO 208	1.8	3.6	5.8	10	—
INTEGRATED MICROCIRCUITS	INTERCHIP A–F	7*	100 TO 650	80 TO 90	32 TO 69	12	17	80	150	3
INTERNATIONAL MICROCIRCUITS	G4000	6*	75 TO 600	—	25 TO 53	35	—	60	—	2
	G7000	3.5	135 TO 2535	—	28 TO 88	3	—	15	—	42
	G9000	2.5	1740 TO 5250	—	64 TO 104	3	5	7	—	45
	1M16000	2	820 TO 6024	—	60 TO 158	1.3	2	5	—	60

I/O CAPABILITY				GENERAL			
NUMBER OF UNCOMMITTED SIGNAL LINES	NUMBER OF INPUT-ONLY LINES/ OUTPUT-ONLY LINES	I/O COMPATIBILITY C = CMOS T = TTL L = LSTTL	MAXIMUM OUTPUT CURRENT (mA)	POWER-SUPPLY RANGE (V)	AMBIENT OPERATING-TEMPERATURE RANGE (°C)	PACKAGES P = PLASTIC DIP C = CERAMIC DIP L = LCC G = PIN-GRID ARRAY S = SURFACE MOUNT	NOTES AND REMARKS
68 TO 146	6 TO 8/0	CTL	24	5	−55 TO +125	CLGS	LEADLESS CHIP CARRIERS AVAILABLE.
68 TO 146	6 TO 8/0	CTL	24	5	−55 TO +125	CLGS	PLASTIC PACKAGES AVAILABLE FOR PRODUCTION RUNS ONLY.
70 TO 216	0/0	CTL	12	3 TO 6	−55 TO +125	PCLGS	LIBRARY HAS 120 MACROCELLS AND 210 MACROFUNCTIONS. ALL CELLS BUILT AND TESTED.
30 TO 86	0/0	CT	48*	4.5 TO 5.5	0 TO 70	PCS	*HCD ARRAYS = 48 mA, DMS ARRAYS = 4.8 mA.
20 TO 180	0/0	CT	10	1.5 TO 10	−55 TO +125	PCLG	
43 TO 93	0/0	CT	6	1.5 TO 10	−55 TO +125	PCLG	
43 TO 93	0/0	CT	4	1.5 TO 10	−55 TO +125	PCLG	
30 TO 156	12/6	CTL	10	2 TO 6	−55 TO +125	PCLGS	
30 TO 204	12/6	CTL	12	2 TO 6	−55 TO +125	PCLGS	
26	0/0	CT	10	3 TO 7	−55 TO +125	PCLS	
48 TO 128	**	CT	10	3 TO 8	−55 TO +125	PCLGS	*6864-GATE ARRAY HAS 8 POWER PADS.
48 TO 128	**	CT	10	3 TO 7	−55 TO +125	PCLGS	**1632 AND 2436-GATE DEVICES HAVE 16 INPUT AND 16 OUTPUT PADS DEDICATED.
48 TO 149	0/0	CT	12	3 TO 6	−55 TO +125	PCLGS	*PLCC J-QUAD PACKAGE AVAILABLE.
72 TO 232	0/0	CT	12	3 TO 6	−55 TO +125	PCLGS	
70 TO 280	0/0	CTE	40	3 TO 6	−55 TO +125	PCLGS	
54 TO 93	2 TO 53/0	CT	4	3 TO 6	−40 TO +85	PCLGS	CONNECT OUTPUTS IN PARALLEL FOR MORE DRIVE.
33 TO 56	2 TO 55/0	CT	4	3 TO 6	−40 TO +85	PCLGS	
37 TO 120	0/0	CTL	10	2.5 TO 15*	−55 TO +125	PCLGS	*3-μm ARRAYS USE 2.5 TO 6V.
22 TO 98	0/0	CT	—	4.5 TO 5.5	0 TO 70	PCLGS	
40 TO 120	0 TO 60/0	CL	8	3 TO 6	−55 TO +125	PCLG	
18 TO 84	0/0	CTL	10	3 TO 15	−55 TO +125	PCLGS	
32 TO 68	0/0	CTL	10	3 TO 15	−55 TO +125	PCLGS	*METAL-GATE TECHNOLOGY. ** $V_{SS} = 15V$, $V_{SS} = 5V$.
38 TO 80	0/0	CTL	10*	4.75 TO 5.25	**	PLGS	* V_{OH}, $I = -0.4$ mA.
110 TO 120	0/0	CTL	3.2*	4.75 TO 5.25	**	PLGS	RAM, ROM ON-CHIP.
106 TO 160	0/0	CTL	3.2*	4.75 TO 5.25	**	PLGS	**COMMERCIAL, INDUSTRIAL, AND MILITARY TEMPERATURE RANGES AVAILABLE.
54 TO 80	0/0	CT	3.2	4.75 TO 5.25	**	PCLGS	***PACKAGE DEPENDENT.
106 TO 160	0/0	CTL	3.2	4.75 TO 5.25	**	PCLGS	
220	0/0	CT	6.4	4.75 TO 5.25	**	PCLGS	
219	0/0	CT	6.4	4.75 TO 5.25	**	PCLGS	
44 TO 200	0/0	CT	42	2 TO 5.5	−55 TO +125	PCLG	TURNKEY TRANSLATION TO STANDARD-CELL IC.
38 TO 62	0/0	CT	1.6	3 TO 6	−40 TO +125	PCL	
38 TO 62	0/0	CT	1.6	3 TO 6	−40 TO +125	PCL	
68 TO 208	0/0	CT	8	2.5 TO 5.5	−55 TO +125	PCLGS	
42 TO 80	0/0	CT	12	3 TO 7	−55 TO +125	PCL	
54 TO 100	0/0	C	3.2	1.5 TO 7	−55 TO +125	PCLG	
40 TO 76	0/0	CT	100	1.5 TO 18	−55 TO +125	PCLG	*TYPICAL. **METAL-GATE TECHNOLOGY.
28 TO 62	0/0	CT	100	1.5 TO 18	−55 TO +125	PCLG	***AT 10V.
112	0/0	CTL	8	3 TO 7	−55 TO +125	CLGS	
140	98/0	CT	5.9	4.5 TO 5.5	−55 TO +125	LG	
40 TO 248	0/0	CT	21	−0.3 TO +6	−55 TO +125	PCLGS	*CHANNELLESS ARCHITECTURE, ROUTING CHANNELS ASSIGNED OVER GATES.
68 TO 172	0/0	CT	16	−0.3 TO +6	−55 TO +125	PCLGS	
68 TO 172	0/0	CT	16	−0.3 TO +6	−55 TO +125	PCLGS	
38 TO 100	4/0	CT	10	3 TO 7	−40 TO +125	PCLG	
44 TO 174	0/0	CT	3.2*	4 TO 6	0 TO 70	PCLGS	*YOU CAN CONNECT AS MANY AS FOUR OUTPUT BUFFERS IN PARALLEL.
44 TO 208	0/0	CT	3.2*	4 TO 6	0 TO 70	PCLGS	
32 TO 69	0/0	CTL	8.5	3 TO 15**	−55 TO +125	PCLGS	*METAL-GATE TECHNOLOGY. **1.5V OPTION AVAILABLE.
33 TO 53	7 TO 9/0	CT	1	2 TO 15	−55 TO +125	PCLG	*METAL-GATE TECHNOLOGY.
28 TO 88	8/0	CT	10	2 TO 10	−55 TO +125	PCLG	
64 TO 104	4/0	CT	10	2 TO 10	−55 TO +125	PCLG	
60 TO 158	6/0	CT	8	2 TO 7	−55 TO +125	PCLG	

Table continued on pg 114

MOS DIGITAL ARRAYS *(Continued)*

			CAPACITY			PERFORMANCE				
MANUFACTURER	PRODUCT LINE	DRAWN TRANSISTOR CHANNEL LENGTH (μm)	NUMBER OF EQUIVALENT 2-INPUT GATES	TYPICAL GATE UTILIZATION (%)	NUMBER OF BONDING PADS (DEDICATED POWER)	INTERNAL GATE DELAYS WITH 2 LOADS, 1mm METAL (nSEC)		OUTPUT-BUFFER DELAYS WITH 50-pF LOAD (nSEC)		MAXIMUM FLIP-FLOP TOGGLE FREQUENCY (MHz)
						TYP	MAX	TYP	MAX	
ITT VLSI DESIGN CENTER	ISDS	3	1008 TO 4400	75 TO 85	44 TO 90	3	8	17	22.5	30
KONTRON	MG*	3	600 TO 2166	—	42 TO 78 (2)	4.7	5.2	13.7	14.7	60
LSI LOGIC	LL5000	3	504 TO 6000	75 TO 90	74 TO 180	2.5	4.5	5.5	9.6	—
	LL7000	2	880 TO 10,000	75 TO 90	68 TO 232	1.4	2.4	7	12	—
	LL8000	2	880 TO 3200	80 TO 90	72 TO 132	1.4	2.4	7	10.5	—
	LL9000	1.5	880 TO 10,000	75 TO 90	28 TO 232	1	1.7	4	7	—
	LCA10,000	1.5	38,000 TO 129,000	35 TO 45	204 TO 370	0.7	1.3	2.5	4.7	—
	LSA2000	2	12,000 TO 45,000	70 TO 80	162 TO 228	1.4	2.4	7	12	—
MARCONI ELECTRONIC DEVICES	MA2000A	3	1000 TO 7000	90	28 TO 136 (2 TO 8)	3.5	4.8	10	17	33
MATRA DESIGN SYSTEMS	MA	3	288 TO 1139	—	28 TO 62 (4)	1.3	3	12	20	20
MCE SEMICONDUCTOR	MGA*	5	220 TO 285	—	21 TO 50 (0 TO 4)	8	10	80	—	12
MITEL	MA-5	5	500 TO 1000	—	38 TO 48 (2)	4	5	—	—	15
	MA-4	4	500 TO 2000	—	38 TO 74 (2 TO 4)	3	4	—	—	20
MITSUBISHI	M60,000	2	500 TO 8000	85 TO 95	16 TO 209 (2 TO 19)	1.1	—	4	—	100
	M60,000	3	200 TO 4800	85 TO 95	16 TO 209 (2 TO 19)	2	—	6	—	40
MOTOROLA	HCA6300*	3	648 TO 4860	80 TO 90	33 TO 84 (0 TO 16)	2.5	4.75	8	15.2	40
	HCA6200*	2	648 TO 5930	80 TO 90	44 TO 124 (0 TO 12)	1.5	3.6	6	11.4	50
NATIONAL SEMICONDUCTOR	SCX6200	2	600 TO 6090	—	—	0.8	1.2	3	5	110
	SCX6300	3	648 TO 6090	—	37 TO 160 (4 TO 16)	1.5	2.5	6	10	70
NCM	3000	7.5*	340 TO 480	80 TO 85	38 TO 48	10	15	21	33	5
	7000	3	780	80 TO 85	62	3	5	9	14	18
	7000	5	780	80 TO 85	62	5	8	12	18	10
NCR MICROELECTRONICS	63XXA	3	648 TO 2450	80	37 TO 107 (2 TO 16)	2.5	—	8.6	16	70
	62XXA	2	648 TO 6500	80	37 TO 107 (2 TO 16)	1.5	—	6	12	85
NEC ELECTRONICS	65XXX	1.5	400 TO 20,000	85 TO 95	54 TO 266 (2)	0.89	1.6	6	10.8	70
OKI SEMICONDUCTOR	MSM70,000	3	387 TO 4200	85	50 TO 188 (2 TO 8)	2.7	5	4.5*	8*	80
	MSM70H000	2	700 TO 10,000	85	50 TO 188 (2 TO 8)	2	4	4.5*	8*	80
	MSM70,000	1.5	1000 TO 3000	85	50 TO 188 (2 TO 8)	1	2	4.5*	8*	80
PLESSEY SOLID STATE	CLA5000	2.5	640 TO 10,044	70 TO 80	40 TO 176 (4 TO 16)	1.6	3.5	2.9	5.8	100
	CLA3000	4	840 TO 6000	70 TO 80	44 TO 112 (4)	2.5	5	12	18	40
RAYTHEON SEMICONDUCTOR	RC 1.5	1.5	3000 TO 7800	80 TO 90	—	1.6	4	—	—	100
RCA SOLID STATE	PA40,000	3	725 TO 1212	85	74 TO 102 (4)	3	5	6	9	40
	PA50,000	3	880 TO 6000	85	74 TO 180 (4)	2.5	3	6	9	40
SAHNI	LAXXX	3	100 TO 1200	75	20 TO 68	3	5	15	20	50
SGS SEMICONDUCTOR	HSG3000	3.5	272 TO 2550	—	36 TO 104 (4)	5	9	7.2	8.6	15
	HSG5000	3	880 TO 6000	—	74 TO 180 (8 TO 12)	2.5	4.5	5.5	6.2	25
SIEMENS AG	SC4B/SC10B	2	4000 TO 10,000	90	116 TO 180 (4 TO 12)	1.5	3	3.5	7	80
	SC1A/SC2A	3	1000 TO 2000	90	40 TO 124 (2 TO 4)	2.5	5	7	15	35

I/O CAPABILITY				GENERAL			
NUMBER OF UNCOMMITTED SIGNAL LINES	NUMBER OF INPUT-ONLY LINES/ OUTPUT-ONLY LINES	I/O COMPATIBILITY C = CMOS T = TTL L = LSTTL	MAXIMUM OUTPUT CURRENT (mA)	POWER-SUPPLY RANGE (V)	AMBIENT OPERATING-TEMPERATURE RANGE (°C)	PACKAGES P = PLASTIC DIP C = CERAMIC DIP L = LCC G = PIN-GRID ARRAY S = SURFACE MOUNT	NOTES AND REMARKS
48 TO 106	0/0	CT	10	3 TO 5.5	−55 TO +125	PCLGS	
42 TO 78	0/0	C	8	—	—	—	
74 TO 180	0/0	CT	12	3 TO 6	−55 TO +125	PCLGS	
68 TO 232	0/0	CT	12	3 TO 6	−55 TO +125	PCLGS	
72 TO 132	0/0	CT	20	3 TO 6	−55 TO +125	PCLGS	
68 TO 232	0/0	CT	12	3 TO 6	−55 TO +125	PCLGS	
204 TO 370	0/0	CT	12	3 TO 6	−55 TO +125	CLGS	CHANNELLESS ARCHITECTURE WITH HIERARCHICAL PLACEMENT. PROGRAMMABLE-SLEW-RATE OUTPUT BUFFERS.
162 TO 228	0/0	CT	12	3 TO 6	−55 TO +125	CLGS	ARRAYS CONTAIN RAM, ROM, AND MEGACELLS SUCH AS ALUs AND MULTIPLIERS.
28 TO 128	*	CT	10	3 TO 8	−55 TO +125	PCLGS	*1600- AND 2400-GATE ARRAYS HAVE 16 DEDICATED-INPUT AND 16 DEDICATED-OUTPUT I/O CELLS.
28 TO 62	0/0	CT	20	3 TO 7	0 TO 70*	PCLG	*OPTIONAL MILITARY TEMPERATURE RANGE.
0	6 TO 24/ 6 TO 24	CT	25	3 TO 18	−55 TO +125	PCLG	*METAL-GATE TECHNOLOGY.
—	ALL/ALL*	CT	12	3 TO 6.5	−55 TO +125	PCL	*PADS ARE EITHER INPUT OR OUTPUT.
—	ALL/ALL*	CT	10	3 TO 6.5	−55 TO +125	PCL	
14 TO 190	0/0	CT	7*	3 TO 6	−20 TO +75	PCGS	CONNECT OUTPUT BUFFERS IN PARALLEL FOR MORE DRIVE.
14 TO 190	0/0	CT	7*	4.5 TO 5.5	−20 TO +75	PCGS	
33 TO 84	0 TO 53/0	CT	4	3 TO 6	−40 TO +85	PCLGS	*"A" VERSIONS OFFER PROGRAMMABLE POWER PADS AND PARALLEL-OUTPUT CAPABILITY.
44 TO 124	0 TO 66/0	CT	10	3 TO 6	−40 TO +85	PCLGS	
38 TO 110	3 TO 66/0	C	4*	4.5 TO 5.5	0 TO 70	PCLG	*6260 DRIVES 6 mA.
37 TO 88	12 TO 66/0	C	25	2 TO 6	−55 TO +125	PCLG	
34 TO 42	4/0	CTL	1.6	5 TO 15	−55 TO +125	PCL	*METAL-GATE TECHNOLOGY.
62	0/0	CTL	1.6	3 TO 10	−55 TO +125	PCL	
62	0/0	CTL	1.6	3 TO 10	−55 TO +125	PCL	
44 TO 84	0/0	CTL	8	3 TO 6	*	PCLGS	*COMMERCIAL, INDUSTRIAL, AND MILITARY RANGES AVAILABLE.
44 TO 149	0/0	CTL	8	3 TO 6	*	PCLGS	
54 TO 256	0/0	CT	12	4.5 TO 5.5	0 TO 70	PCLGS	OUTPUT BUFFER TOGGLE FREQUENCY = 50 MHz MAX.
48 TO 172	0/0	CT	24	3 TO 6	−40 TO +85	PCGS	*20-pF LOAD.
48 TO 172	0/0	CT	24	3 TO 6	−40 TO +85	PCGS	
48 TO 172	0/0	CT	24	3 TO 6	−40 TO +85	PCGS	
36 TO 160	4 TO 16/0	CT	6.4	3 TO 6	−55 TO +125	PCLG	
40 TO 108	4/0	CT	6.4	3 TO 6	−55 TO +125	PCLG	
90 TO 142	0/0	CTL	—	4 TO 6	−55 TO +125	LG	
58 TO 86	0/0	C	2.4	3 TO 6	−55 TO +125*	PCLGS	* −40 TO +85 TEMPERATURE RANGE AVAILABLE.
56 TO 86	0/0	CT	2.4	3 TO 6	−55 TO +125*	PCLGS	
20 TO 68	0/0	—	8	2 TO 6	0 TO 70*	PCLGS**	* −55 TO +125 TEMPERATURE RANGE AVAILABLE. **DIE ALSO AVAILABLE UNPACKAGED OR IN WAFERS.
—	—	CT	4.8	3 TO 6	−55 TO +125*	PCLGS	* −40 TO +85 AND 0 TO 70 TEMPERATURE RANGES AVAILABLE.
—	—	CT	6	3 TO 6	−55 TO +125*	PCLGS	
112 TO 168	0/0	CT	8	3 TO 6	0 TO 70	PCLG	
38 TO 120	0/0	CT	2	3 TO 6	0 TO 70	PCLG	

Table continued on pg 116

MOS DIGITAL ARRAYS *(Continued)*

MANUFACTURER	PRODUCT LINE	DRAWN TRANSISTOR CHANNEL LENGTH (μm)	CAPACITY: NUMBER OF EQUIVALENT 2-INPUT GATES	CAPACITY: TYPICAL GATE UTILIZATION (%)	CAPACITY: NUMBER OF BONDING PADS (DEDICATED POWER)	PERFORMANCE: INTERNAL GATE DELAYS WITH 2 LOADS, 1mm METAL (nSEC) TYP	PERFORMANCE: INTERNAL GATE DELAYS WITH 2 LOADS, 1mm METAL (nSEC) MAX	PERFORMANCE: OUTPUT-BUFFER DELAYS WITH 50-pF LOAD (nSEC) TYP	PERFORMANCE: OUTPUT-BUFFER DELAYS WITH 50-pF LOAD (nSEC) MAX	PERFORMANCE: MAXIMUM FLIP-FLOP TOGGLE FREQUENCY (MHz)
SILICON SYSTEMS	—	3	<10,000	—	<40	2	7.4	10	14	40
SILICONIX	Si6000	2	500 TO 6200	90	48 TO 154 (4 TO 8)	1.7	3	6	12	50
SMOS SYSTEMS	SLA5000	3	413 TO 3082	—	46 TO 108	3	5.4	10	18	50
	SLA6000	2	820 TO 4342	—	60 TO 126	2	3.6	5	9	70
SOREP	RPS5000	2	500 TO 10,000	80 TO 85	48 TO 112	—	1.6	—	5.4	100
STC MICROTECHNOLOGY	7C	3	600 TO 1920	—	38 TO 96 (8)	—	5	—	13	50
	TMG3000	5*	50 TO 216	—	22 TO 44	13	—	—	—	5
	TMG4000	6	300 TO 1260	—	40 TO 78	5	12	—	—	33
TEXAS INSTRUMENTS	TAC-H	2.8	440 TO 3900	90	54 TO 68 (4)	4	—	12	—	60
	TAC-VH	2.3	2640 TO 8000	90	106 TO 160 (4)	2.5	—	7	—	75
TLSI	TA-X	5	300 TO 1260	70 TO 80	40 TO 78 (2)	6	10	—	—	10
	TA-500–2500	3	540 TO 2500	70 TO 80	40 TO 84 (2)	2	2.5	9	11	25
TOSHIBA AMERICA	TC22SC	2	470 TO 10,000	100	26 TO 144	1.5	3	5.75	11.5	100
	TC19G	1.5	3200 TO 10,000	80	128 TO 232	1	2	4	8	120
	TC17G	2	540 TO 10,000	80	48 TO 232	1.5	3	5.75	11.5	100
	TC11SG	1.5	5330 TO 129,042	40	84 TO 370	0.7	1.4	—	—	120
TRIQUINT SEMICONDUCTOR	Q-CHIP*	1	140	75 TO 100	44 (20)	0.15	0.20	0.20**	0.26**	2000
UNIVERSAL	ISO-2	2	99 TO 2400	—	22 TO 98 (2)	1.1	2	3	5.5	60
	ISO-3	3	99 TO 2400	—	22 TO 98 (2)	1.6	2.9	4.5	8.5	40
	ISO-5	5	99 TO 2400	—	22 TO 98 (2)	3.2	6.2	8	15	20
VATIC SYSTEMS	MA1	3	500 TO 2200	70 TO 80	36 MIN	2.7	3.2	15	20	50
VLSI TECHNOLOGY	VCG	2	500 TO 8000	80 TO 95	44 TO 200 (4 TO 16)	1.1	—	4	5.1	50

BIPOLAR DIGITAL ARRAYS

MANUFACTURER	PRODUCT LINE	TECHNOLOGY	CAPACITY: NUMBER OF EQUIVALENT 2-INPUT GATES	CAPACITY: TYPICAL GATE UTILIZATION (%)	CAPACITY: NUMBER OF BONDING PADS (DEDICATED POWER)	PERFORMANCE: INTERNAL GATE DELAYS WITH 2 LOADS, 1-mm METAL (nSEC) TYP	PERFORMANCE: INTERNAL GATE DELAYS WITH 2 LOADS, 1-mm METAL (nSEC) MAX	PERFORMANCE: OUTPUT-BUFFER DELAYS WITH 50-pF LOAD (nSEC) TYP	PERFORMANCE: OUTPUT-BUFFER DELAYS WITH 50-pF LOAD (nSEC) MAX	PERFORMANCE: MAXIMUM FLIP-FLOP TOGGLE FREQUENCY (MHz)
APPLIED MICRO CIRCUITS	Q700	ECL	250 TO 1000	85	34 TO 76 (6 TO 8)	0.5 TO 0.9	—	2.95	—	125
	Q1500	ECL	1500 TO 1700	95	84 TO 120 (10 TO 28)	0.5 TO 0.9	—	2.1	—	125
	Q3500***	ECL	1300 TO 3500	95	76 TO 120 (16 TO 28)	0.7 TO 2.75	—	0.8	—	400
ADVANCED MICRO DEVICES	Am1850	ECL/TTL	1800	90	—	0.8	1.2	1.3	1.9	200
	Am3500	ECL/TTL	3700 TO 5200	95	124 TO 138 (20 TO 26)	0.4 TO 0.6*	0.95*	0.7	1.1	500
CHERRY SEMI-CONDUCTOR	GENESIS	I^{2}L	192 TO 288	70 TO 80	30 TO 34	50*	100*	25	50	2
CUSTOM INTEGRATED CIRCUITS	GAC8000	I^{2}L	7600*	—	64	20	**	**	**	10

I/O CAPABILITY				GENERAL			
NUMBER OF UNCOMMITTED SIGNAL LINES	NUMBER OF INPUT-ONLY LINES/ OUTPUT-ONLY LINES	I/O COMPATIBILITY C = CMOS T = TTL L = LSTTL	MAXIMUM OUTPUT CURRENT (mA)	POWER-SUPPLY RANGE (V)	AMBIENT OPERATING-TEMPERATURE RANGE (°C)	PACKAGES P = PLASTIC DIP C = CERAMIC DIP L = LCC G = PIN-GRID ARRAY S = SURFACE MOUNT	NOTES AND REMARKS
<40	0/0	CT	25	4.5 TO 5.5	−55 TO +125	PCL	
48 TO 154	6/0	CTL	16	3 TO 7	−55 TO +125	PCLGS	
46 TO 108	8/0	CT	6	4.75 TO 5.25	0 TO 70	PCLG	
60 TO 106	6/0	CT	6	4.75 TO 5.25	0 TO 70	PCLG	
160	0/0	CT	6.4	4 TO 6	−55 TO +125	PCLGS	
38 TO 96	0/0	T	—	4.75 TO 5.25	0 TO 70	PG	
—	—	CT	4	3 TO 15	−55 TO +125	PCLG	* METAL-GATE TECHNOLOGY.
—	—	CT	—	3 TO 10	−55 TO +125	PCLG	
54 TO 80	0/0	CT	2	4.75 TO 5.25	0 TO 70	PCLG	
106 TO 160	0/0	CT	4	4.75 TO 5.25	0 TO 70	PCLG	
37 TO 75	3/0	CT	4	3 TO 12	−55 TO +125	PCLGS	
40 TO 84	0/0	CT	4.8	2.5 TO 6	−55 TO +125	PCLGS	
26 TO 144	0/0	CT	8	4.75 TO 5.25	0 TO 70*	PCLGS**	*YOU CAN REQUEST EXTENDED TEMPERATURE RANGE. **PLATPACK PACKAGES AVAILABLE.
128 TO 232	0/0	CT	12	4.75 TO 5.25	0 TO 70*	PCLGS**	
48 TO 232	0/0	CT	8	4.75 TO 5.25	0 TO 70*	PCLGS**	
84 TO 370	0/0	CT	12	4.75 TO 5.25	0 TO 70*	PCLGS**	
24	0/0	CT***	32	−3 AND +4, ±10%	0 TO 85	L	*GaAs TECHNOLOGY. **50Ω LOAD. ***ECL-I/O COMPATIBLE.
18 TO 90	0/0	CT	10	3 TO 7	−55 TO +125	PCL	PROGRAMMABLE SOURCE AND DRAIN CONTACTS.
18 TO 90	0/0	CT	6	3 TO 8	−55 TO +125	PCL	
18 TO 90	0/0	CT	3	3 TO 15	−55 TO +125	PCL	
34 TO 70	0/0	CT	1.6	3 TO 6	−55 TO +125	PCLGS	
40 TO 118	0 TO 63/0	CT	10	4.5 TO 5.5	−40 TO +85	PCLGS	

	I/O CAPABILITY				GENERAL			
TYPICAL POWER DISSIPATION PER GATE (mW)	NUMBER OF UNCOMMITTED SIGNAL LINES	NUMBER OF INPUT-ONLY LINES/ OUTPUT-ONLY LINES	I/O COMPATIBILITY T = TTL L = LSTTL E = ECL C = CMOS	MAXIMUM OUTPUT CURRENT (mA)	POWER-SUPPLY RANGE (V)	AMBIENT OPERATING-TEMPERATURE RANGE (°C)	PACKAGES P = PLASTIC DIP C = CERAMIC DIP L = LCC G = PIN-GRID ARRAY S = SURFACE MOUNT	NOTES AND REMARKS
1.8.	8 TO 38	26 TO 28/0	TE	20 (TTL)*	−5.2 AND +5, ±10%	−55 TO +125	CLGS**	*ECL OUTPUT 50Ω. **LDCC AVAILABLE.
1.7	0 TO 60	46 TO 60/ 0 TO 38	TE	20	−5.2 OR −4.7 AND +5, ±10%	−55 TO +125	CLGS**	ECL 10K AND 100K SUITABLE. MIL-STD-883C SUPPORT OPTIONAL. YOU CAN SPECIFY CUSTOM MACROS. ***SPEED-POWER PROGRAMMABLE OPTIONS. QM1600S INCLUDES 1280 BITS OF RAM.
1	76 TO 120	0/0	TE	20	−5.2 OR −4.7 AND +5, ±10%	−55 TO +125	CLGS**	
1.5	75	5/0	LEC	16	−5.2 TO +5, ±10%	0 TO 70	CLGS	
1 TO 4*	76 TO 124	0 TO 58/0	LEC	32	−5.2 TO +5, ±10%	0 TO 70	G	*SPEED-POWER OPTION. Am3525 CONTAINS 1152 BITS OF RAM.
**	24 TO 28	0/0	TLEC	10	1 TO 12	0 TO 85	PCLS	*INJECTOR-CURRENT DEPENDENT. **PROGRAMMABLE.
**	62	0/0	TL	—	0.6 TO 5.5	−55 TO +125	PCL	*5-INPUT GATES. **PROGRAMMABLE.

Table continued on pg 118

BIPOLAR DIGITAL ARRAYS *(Continued)*

			CAPACITY			PERFORMANCE				
MANUFACTURER	PRODUCT LINE	TECHNOLOGY	NUMBER OF EQUIVALENT 2-INPUT GATES	TYPICAL GATE UTILIZATION (%)	NUMBER OF BONDING PADS (DEDICATED POWER)	INTERNAL GATE DELAYS WITH 2 LOADS, 1-mm METAL (nSEC)		OUTPUT-BUFFER DELAYS WITH 50-pF LOAD (nSEC)		MAXIMUM FLIP-FLOP TOGGLE FREQUENCY (MHz)
						TYP	MAX	TYP	MAX	
CUSTOM SILICON	MCA600-1200ECL	ECL	652 TO 1192	70 TO 85	28 TO 72 (12)	0.7	1.2	2.0	3.8	160
	MCA2500 ECL	ECL	2472	70 TO 85	149 (28)	0.3	0.5	0.75	0.88	700
	MCA500-1300ALS	TTL	533 TO 1280	70 TO 85	28 TO 84 (4)	2.3	3	12	14	80
	MCA2800 ALS	TTL	2720	70 TO 85	149 (4)	0.8	1.1	6	8.2	125
	MCA2900 ETL	ECL TTL	2958	70 TO 85	149 (28)	0.7 & 1.1*	1.2 & 1.8*	0.8 & 3.2*	1.5 & 5.3*	125
FAIRCHILD	FGE	ECL	100 TO 2840	85	24 TO 156 (30)	0.35	0.47	1.8	2.5	1000
FERRANTI/ INTERDESIGN	ULA R	CML	130 TO 2000	70 TO 95	20 TO 80	2.9	5.2	8	14	80*
	ULA DS	CML	512 TO 10,000	95	42 TO 190	1.4	2.5	8	14	130**
FUJITSU MICRO-ELECTRONICS	H-BIPOLAR	LSTTL	360 TO 1680	90	44 TO 103 (4 TO 15)	1.25	—	4.5	—	150
	B2000-BIPOLAR	LSTTL	3162	90	136 (24)	0.95	—	3.5	—	200
	ET 3000	ECL	4200	>90	144 (28)	0.22	0.35	3.7	5.9	1100
HONEYWELL	HE2000	CML	2000	80 TO 95	140 (32)	0.3	1	1	2	660
	HT5000	CML	5000	65 TO 75	120 (24)	0.6	0.8	6	12	500
	HM1000R	CML*	1000	65 TO 75	60 (16)	0.7	1.5	4.4	5.7	400
	HE8000	CML	8000	85 TO 90	188 (56)	0.3	1	0.7	1	500
	HM3500	CML*	3500	80 TO 90	120 (32)	0.4	0.8	1	2	600
MOTOROLA	MCA I-ECL	ECL	625 TO 1192	80 TO 90	46 TO 60 (8 TO 12)	0.8	1.2	2.1	3.1	250
	MCA II-ECL	ECL	902 TO 2472	80 TO 90	54 TO 120 (8 TO 28)	0.3	0.5	0.6	0.9	770
	MCA I-TTL	ECL**	533 TO 1280	80 TO 90	57 TO 76 (7 TO 8)	1.4	3	9.8	14	80
	MCA II-TTL***	ECL**	1800 TO 2720	80 TO 90	120 (28)	0.9	1.15	5	7.5	125
	BIMOS****	CMOS/ BIPOLAR	6000	80 TO 90	202 (52)	0.9	1.15	1.25	5.5	>80
	MCA III-ECL	ECL*****	10,000	80 TO 90	256 (42)	0.15	0.175	0.6	0.9	>1000
NEC ELECTRONICS	µPB63XX	ECL	600 TO 5000	95	88 TO 172 (10)	0.25	0.375	1	1.5	500
RAYTHEON SEMI-CONDUCTOR	R-OI/ISL	ISL	3500 TO 5000	60 TO 80	120 TO 150	1.2*	2	—	—	125
	R-JI/ISL	ISL	800 TO 2400	60 TO 80	48 TO 96	2.3***	3	—	—	75
SIEMENS AG	SH 100C	OXIS II	960 TO 2500	90	66 TO 144 (6 TO 24)	0.45	0.6	—	—	750
SIGNETICS	TURBO ACE	ECL	600 TO 2700	80 TO 90	64 TO 144 (6 TO 16)	0.35	0.65	0.9	1.25	600
	LOW-POWER ACE	ECL	600 TO 2700	80 TO 90	64 TO 144 (6 TO 16)	0.45	0.65	1.1	1.5	400
TEXAS INSTRUMENTS	TAB	LSTTL	240 TO 1120*	—	40 TO 88 (2)	1.9	—	6.5	—	150
	TAL	TTL	320 TO 500	—	28 TO 36 (4)	6	6.8	9	11	25
	TAT	STL	540 TO 1008	—	56 TO 100 (8)	2.8	4.3	9.5	15	80
VATIC SYSTEMS	BA2	ECL/TTL	748 TO 1712	90	52 TO 88 (8 TO 13)	1	1.3	2.1	3	225

	I/O CAPABILITY				GENERAL			
TYPICAL POWER DISSIPATION PER GATE (mW)	NUMBER OF UNCOMMITTED SIGNAL LINES	NUMBER OF INPUT-ONLY LINES/ OUTPUT-ONLY LINES	I/O COMPATIBILITY T = TTL L = LSTTL E = ECL C = CMOS	MAXIMUM OUTPUT CURRENT (mA)	POWER-SUPPLY RANGE (V)	AMBIENT OPERATING-TEMPERATURE RANGE (°C)	PACKAGES P = PLASTIC DIP C = CERAMIC DIP L = LCC G = PIN-GRID ARRAY S = SURFACE MOUNT	NOTES AND REMARKS
4	18 TO 26	28 TO 34/0	E***	30 (50Ω)	−5.2 ±10%	0 TO 70	PCLG	*SPECS FOR ON-CHIP ECL AND TTL CIRCUITRY, RESPECTIVELY.
3	68	52/0	E**	30 (50Ω)	−4.2 TO −4.8	0 TO 70	G	**10K, 10KH, AND 100K ECL CIRCUITS.
2	12 TO 40	30 TO 30/ 0 TO 15	TL	24	4.5 TO 5.5	0 TO 70	PCL	***10K AND 10KH ECL CIRCUITS.
0.9	120	0/0	TL	8	4.5 TO 5.5	0 TO 70	LG	
1.3	48 & 40	72 & 30/0	LE	30	−5.2 AND +5, ±10%	0 TO 70	G	
2.5 TO 9	21 TO 126	0 TO 62/ 21 TO 64	TLEC	20	−4.5 TO −5.7	−10 TO +150	CLGS	
0.025 TO 1*	38 TO 72	0/0	TLEC	64	4.5 TO 5.5	−55 TO +125	PCLGS	*FOUR SPEED-POWER OPTIONS.
0.08 TO 0.5**	40 TO 180	0/0	TLEC	64	4.5 TO 5.5	−55 TO +125	PCLGS	**THREE SPEED-POWER OPTIONS.
0.85	44 TO 88	0/0	TL	48	4.75 TO 5.25	*	PCGS	*MILITARY, INDUSTRIAL, AND COMMERCIAL TEMPERATURE RANGES AVAILABLE.
0.65	112	0/0	TL	16	4.75 TO 5.25**	0 TO 70	G	**2.1 TO 2.5V OPERATION POSSIBLE.
2.4	120	120/72	TE	16 TO 60	4.5 TO 5.5	0 TO 70	G***	***CERAMIC FLATPACK AVAILABLE.
3.3	140	0/0	E	4	−3.3 ±5%	0 TO 70	G	
1	120	44/76	TL	8	5 AND 3.3, ±10%	−55 TO +125	LG	
3	60	0/0	TLE	8	4.5 TO 5.5	−55 TO +125	LGS	*RAD HARD.
1.3	188	0/0	E	4	−3.3 TO −5.2	0 TO 70	E	
1	120	0/0	TLE	8	−3.3 TO −5.2, 3.3 TO 5	−55 TO +125	LG	
3.3	18 TO 26	28 TO 34/0	E	*	−5.2 ±10%	0 TO 70	CLG	*25Ω TO −0.2V.
2.6	22 TO 68	32 TO 52/0	E	*	−4.5 TO −5.2, ±10%	0 TO 70	CLG	
1.8	13 TO 31	35 TO 36/9	TL	24	4.75 TO 5.25	0 TO 70	PCLS	**ALS I/O CELLS.
0.9	120	0/0	TL	8	4.75 TO 5.25	0 TO 70	LG	***INCLUDES 16×8 MULTIPORT RAM.
0.022/MHz	202	0/0	TLEC	24 (25Ω)	−5.2 AND 5, ±10%	0 TO 70	G	****AVAILABLE IN MID 1986.
2	256	0/0	E	25Ω TO −2V	−5.2 ±5%	0 TO 70	G	*****AVAILABLE IN 2ND HALF 1986.
3.3	—	—	TLEC	8	4.5 TO 5.5	0 TO 70	G	
0.16	120 TO 150	0/0	TL	16	5**	−55 TO +125	LG	*1 nSEC WITH PULL-UP RESISTOR. **LOGIC CIRCUITRY NEEDS ONLY 1.5V.
0.4	48 TO 96	0/0	TL	16	5**	−50 TO +125	CLG	***1.8 nSEC WITH PULL-UP RESISTOR.
2	58 TO 120	30 TO 60/ 0 TO 8	E	80	−4.5 ±10%	0 TO 70	G	
8.5	28 TO 128	0 TO 30/ 0 TO 30	LE	*	−5.2 OR −4.7, ±5.%	30 TO 125	GS**	*25Ω. **FLATPACK AVAILABLE.
4.25	28 TO 128	0 TO 30/ 0 TO 30	LE	*	−5.2 OR −4.7, ±5%	30 TO 125	GS**	ACE 1320 HAS 320 BITS OF RAM, ACE 30T00 HAS 1280 BITS OF RAM.
0.8	40 TO 88	0/0	TL	24	4.75 TO 5.25	0 TO 70	PCLG	*3-INPUT NANDs.
1.2	28 TO 42	0/0	TL	8	4.75 TO 5.25	0 TO 70	P	
0.67	38 TO 52	0/0	TL	8	4.5 TO 5.5	0 TO 70	PLG	
1	52 TO 88	0/0	TLEC	16	−5.2 AND 5, ±10%	−55 TO +125	PCLGS	*FOUR SPEED-POWER OPTIONS.

Table continued on pg 120

LINEAR/DIGITAL ARRAYS

MANUFACTURER	PRODUCT LINE	TECHNOLOGY	CAPACITY						
			NUMBER OF DEDICATED 2-INPUT LOGIC GATES	NUMBER OF BONDING PADS (DEDICATED POWER)	NUMBER OF NPN OR NMOS TRANSISTORS		NUMBER OF PNP OR PMOS TRANSISTORS		TOTAL DIFFUSED OR P-WELL RESISTANCE (Ω)
					$I_C, I_D < 100$ mA	$I_C, I_D > 100$ mA	$I_C, I_D < 100$ mA	$I_C, I_D > 100$ mA	
AT&T TECHNOLOGY SYSTEMS	R7XXX	BIPOLAR	—	30 TO 48	67 TO 196	1 TO 2	60 TO 116	1 TO 2	1.5M TO 3M
CHERRY SEMICONDUCTOR	GENESIS	I^2L	64 TO 1400	16 TO 40	48 TO 145	2 TO 8	15 TO 56	0	180k TO 4.78M
CUSTOM INTEGRATED CIRCUITS	MSB	BIPOLAR	0	38	84	0	40	0	—
DATA LINEAR	DL031 TO 124	BIPOLAR	0	18 TO 40	15 TO 60	2 TO 8	11 TO 44	2 TO 8	45k TO 180k
ELECTRONIC TECHNOLOGY	A2S, A3S, A7S	BIPOLAR	0	14 TO 40	196	8	74	0	557k
EXAR	MASTER CHIPS	BIFET	0	40 MAX	208 MAX	8 MAX	74 MAX	0	712k
FERRANTI INTERDESIGN	MACRO-CHIPS	BIPOLAR	0	14 TO 46	35 TO 241	1 TO 8	3 TO 98	0	93k TO 1.03M
	MONOCHIP	BIPOLAR	0	14 TO 40	22 TO 178	4	8 TO 64	0	180k TO 1.01M
	MLB/A	METAL-GATE CMOS	8 TO 135	32 TO 40	251 TO 440	0	250 TO 440	0	1M TO 2M
	DIGILIN ULA PA, PB	BIPOLAR	128 TO 1152	26 TO 54	160 TO 384	3	0	0	327k TO 567k
	DIGILIN ULA G	BIPOLAR	30 TO 578	18 TO 44	122 TO 434	2	0	0	514k TO 1.29M
HOLT	HI-3700	METAL-GATE CMOS	153*	50 (2)	**	**	**	**	155k
INTEGRATED MICROCIRCUITS	IMC-20	BIPOLAR	—	24 MAX	92 MAX	4 MAX	36 MAX	14 MAX	345k
	IMC-40	BIPOLAR	—	20 MAX	60 MAX	4 MAX	22 MAX	6 MAX	237k
LINEAR TECHNOLOGY	LA200	BIPOLAR	—	14 TO 24	25 TO 83	2	9 TO 26	0	170k TO 450k
	LA250	BIPOLAR	—	24 TO 40	68 TO 148	2 TO 4	20 TO 49	—	340k TO 1M
MCE SEMICONDUCTOR	MCE-A	BIPOLAR	0	14 TO 28	48 TO 141	0 TO 8	8 TO 52	0 TO 14	94k TO 712k
MICRO LINEAR	FB300	BIPOLAR	120*	24 TO 44	159 TO 273	0 TO 4	99 TO 108	0	437k TO 805k
	FB900	BIPOLAR	0	18 TO 28	36 TO 141	2 TO 8	12 TO 52	0	159k TO 712k
NCM	5000	BIPOLAR	0	16	56	2	17	2	220k
POLYCORE ELECTRONICS	MAXICHIP	BIPOLAR	0	10 TO 40	6 TO 100	0 TO 3*	3 TO 25	0	54k TO 315k
RAYTHEON SEMICONDUCTOR	RLA120	BIPOLAR	0	24	39	4	16	0	5.02M
SAHNI	MFA XXX	BIPOLAR	0	20 TO 40	62 TO 243*	62 TO 243	62 TO 243	0	167k TO 758k
SIEMENS AG	SH 133C	BIPOLAR	0	24 (3)	89	0	0	0	32.1k
SILICON SYSTEMS	UFA	CMOS	12	32 TO 54	120 TO 238	0	300 TO 628	0	20k to 40k
STC MICROTECHNOLOGY	7BD	BIPOLAR	0	34	256	0	32	0	1.0M
	7BG	BIPOLAR	0	18 TO 40	64 TO 256	0	8 TO 32	0	149k TO 596k
TELMOS	TMG6000	Si-GATE CMOS	128 TO 930	30 TO 62	135 TO 350	0	135 TO 350	0	2.4M TO 8.9M
TEKTRONIX IC OPERATION	QUICKCHIP 2	BIPOLAR	0	28 TO 68	142 TO 466	3 TO 8	70 TO 240	0	615k TO 2.1M
	QUICKCHIP 3	BIPOLAR	0	28	198	6	48	0	994k
VATIC SYSTEMS	POLYUSE	BIPOLAR	0	24 TO 40	60 TO 135	2 TO 4	38 TO 72	0	1.2M TO 2.4M
VTC	VJ8XX	BIPOLAR	0	28 TO 40	165 TO 590	0 TO 10	24 TO 36	0	79k TO 250k

			PERFORMANCE		GENERAL			
NUMBER OF PINCH OR POLYSILICON RESISTORS	NUMBER OF CAPACITORS (PROGRAMMABLE)	CAPACITANCE RANGE (pF)	TYPICAL SMALL-SIGNAL NPN OR NMOS F_t (I_C, I_D = 1 mA, IN MHz)	TYPICAL SMALL-SIGNAL NPN OR NMOS h_{fe} (I_C, I_D = 1 mA, IN MHz)	POWER-SUPPLY RANGE (V)	AMBIENT OPERATING-TEMPERATURE RANGE (°C)	PACKAGES P = PLASTIC DIP C = CERAMIC DIP L = LCC G = PIN-GRID ARRAY S = SURFACE MOUNT	NOTES AND REMARKS
1	6 TO 16	2 TO 15	300	100	1 TO 30	−40 TO +85	PCLGS	
5 TO 16	0	—	400*	150	1 TO 20**	−55 TO +125	PCLGS	*800 MHz ON 7600 ARRAY. **12V ON 1100 AND 1400 ARRAYS.
0	124 TO 248	0.3 TO 50	200	100	1 TO 20	−55 TO +125	PCL	
2 TO 4	(2 TO 7)	0 TO 350	1000*	250	1 TO 35*	−55 TO +125	PCLG	*DL031 TO 124 P_t = 600, DL231 TO 324 V = 20 MAX.
16	8 (8)	0.5 TO 125	500	180	1 TO 75	−55 TO +125	PCLGS	
9	8	10 MAX	300*	200	1.5 TO 75	−55 TO +125	PCLGS	*HIGH-SPEED OPTION YIELDS 700 MHz.
2 TO 28	1 TO 3	20 TO 75	400	200	1 TO 20*	−55 TO +125	PCLS	*OPTION TO 30V.
2 TO 12	0	0	350	200	1 TO 36	−55 TO +125	PCLS	
—	84	1.7 EACH	—	20	1 TO 18	−50 TO +125	PCLS	
128 TO 352	2	35	2M	140	1 TO 15	−55 TO +125	PCLGS	1007 TOTAL LINEAR ELEMENTS MAX.
100 TO 360	2	35	2 **	140	1 TO 5.5	−55 TO +125	PCLGS	**OP AMP UNITY-GAIN BANDWIDTH.
0	(7)	0.5 TO 22	—	—	1.3 TO 18	−55 TO +125	PCLG	*INCLUDES 22 DEDICATED FLIP FLOPS. **PREDESIGNED ANALOG CIRCUITS.
12	0	—	300	150	3 TO 20	−55 TO +125	PCLGS	
6 MAX	0	—	300	150	3 TO 40	−55 TO +125	PCLGS	
6 TO 10	3	56 TO 75	275	200	1.3 TO 20	−40 TO +125	PCS	
20 TO 28	4	56 TO 75	275	200	1.3 TO 20	−40 TO +125	PCS	
2 TO 16	0	—	—	—	—	−55 TO +125	PCLG	
0	7 TO 13	10 MAX	1000	150	12 MAX	−55 TO +125	PCL	*FB330 ONLY. MACROCELLS AVAILABLE.
4 TO 16	0	—	300	150	20 MAX	−55 TO +125	PCL	MACROCELLS AVAILABLE.
8	2	20 TO 100	180	100	5 TO 15	−55 TO +125	PCL	
0 TO 2	0	—	1000	150	—	—	PCL	
0	0	—	500	200	3 TO 36*	−55 TO +125	PCL	*±1.5 TO ±18V RANGE AVAILABLE. 12 CONFIGURABLE LINEAR BLOCKS ON-CHIP.
2 TO 9	0	—	350	150	20 MAX	−55 TO +125	PCLGS**	*TRANSISTOR CELL IMPLEMENTS NPN OR LATERAL PNP. **DIE AVAILABLE UNPACKAGED OR AS WAFERS.
0	0	—	4000	—	4 TO 6	0 TO 70	PCLS	
0	(360 TO 720)	0 TO 1	10	100	7 TO 15	0 TO 70	PCL	
—	—	—	500	100	15 TO 40	−55 TO +125	PC	
—	—	—	1500	80	15 TO 40	−55 TO +125	PC	
—	—	98 TO 740	—	100	2 TO 10	−55 TO +125	PCLGS	
*	40 (20)	0 TO 1	6500	80	3 TO 32	−55 TO +125	PCL	*LASER-TRIM NICHROME RESISTORS AVAILABLE.
*	36 (16)	0 TO 1	2500	90	8 TO 95	−55 TO +125	PCL	NPN COLLECTOR BASE BREAKDOWN VOLTAGE >65V.
0	—	0.1 TO 20	550	140	20 MAX	−55 TO +125	PCLS	
0	8 TO 18	5	1000	100	5 TO 12	−55 TO +125	PCS*	*FLATPACK, PLCC, AND TAB PAK PACKAGES AVAILABLE.

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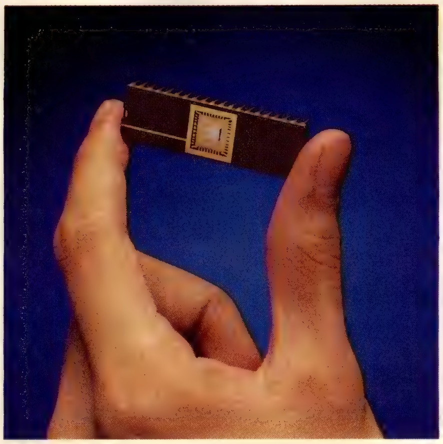

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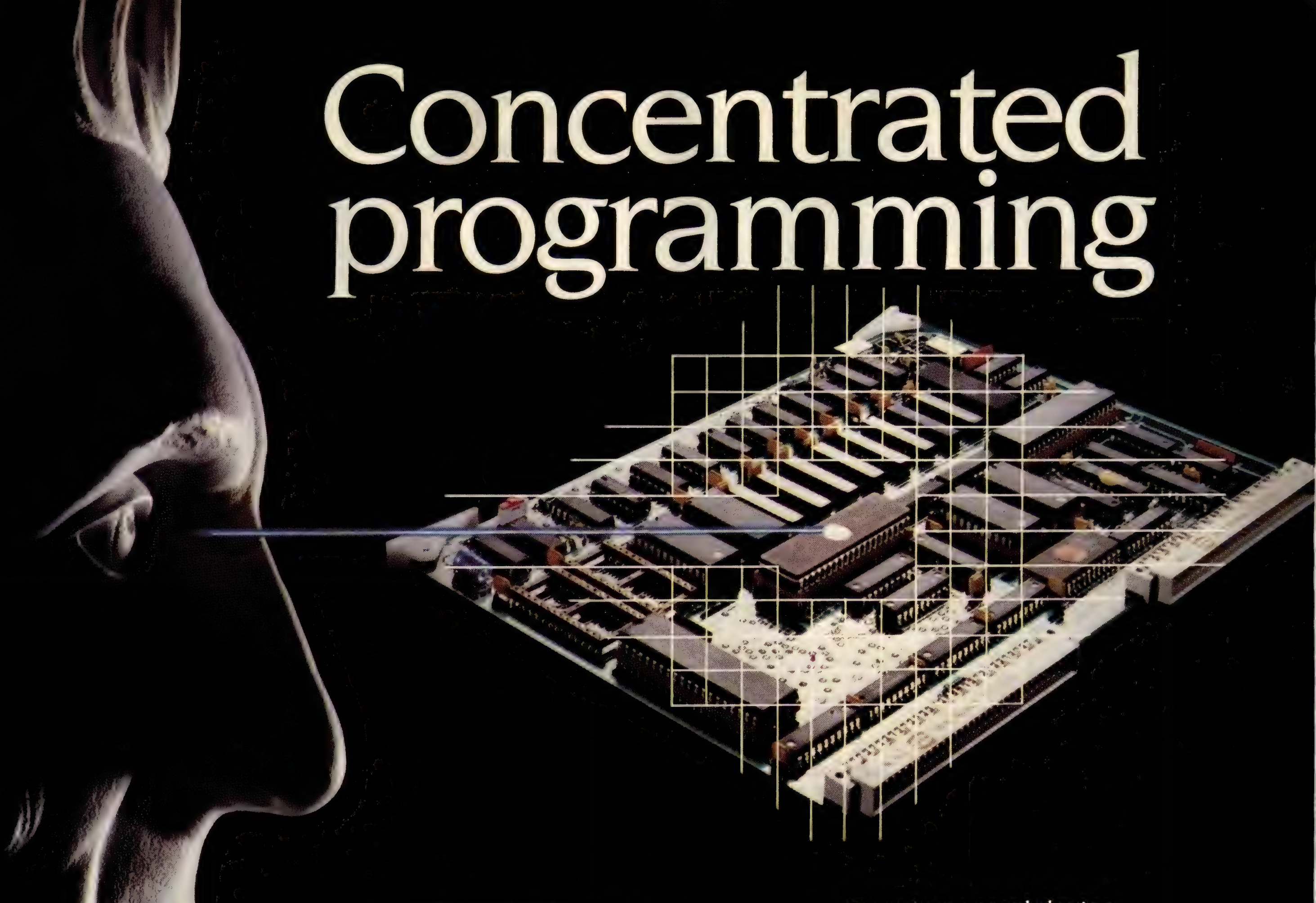

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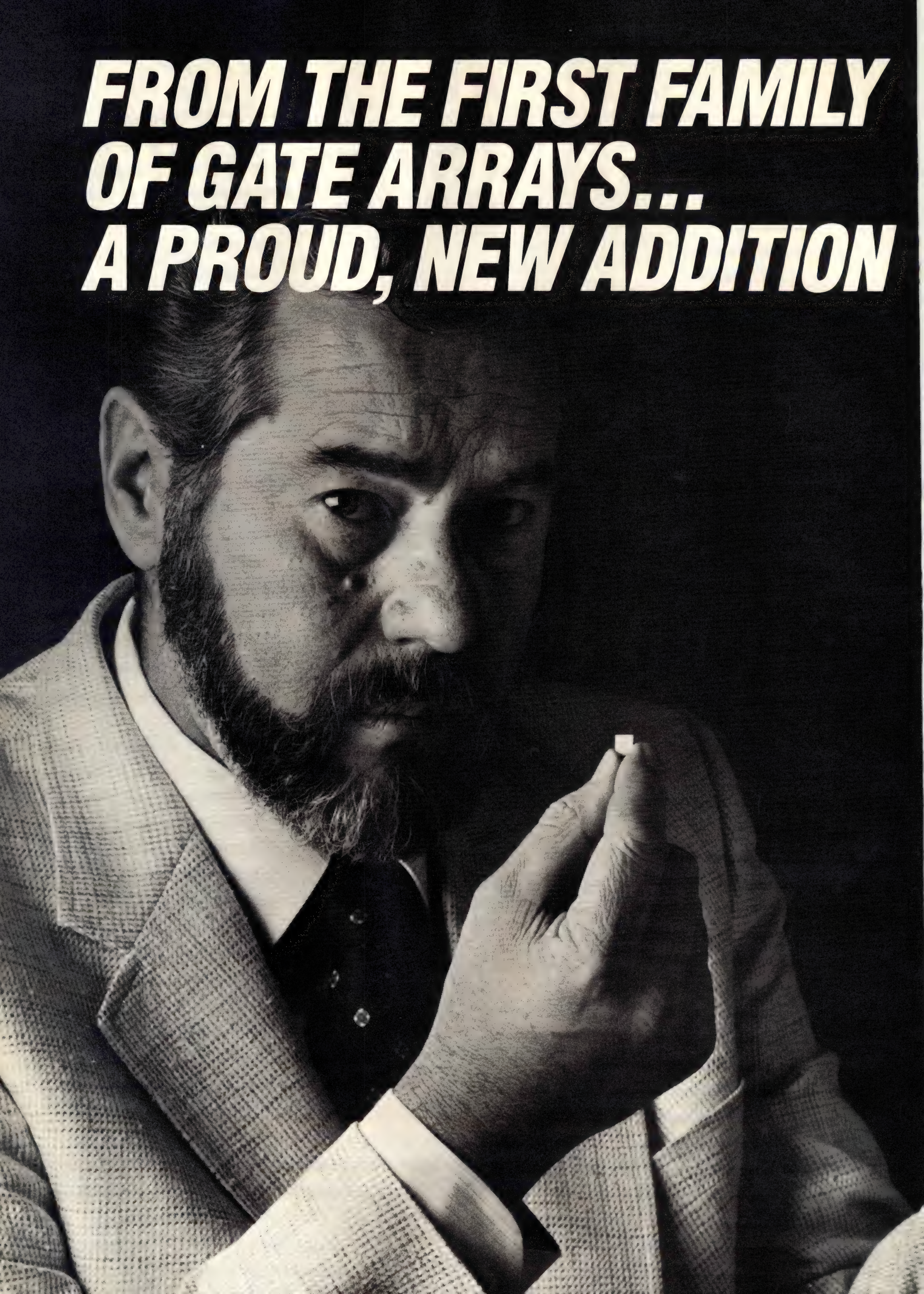
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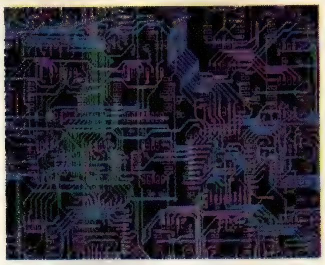

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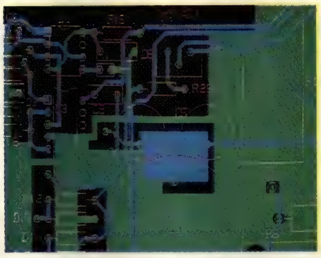

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Bipolar arrays:
901 Thompson Pl
Sunnyvale, CA 94088
(408) 732-2400

CMOS arrays:
5900 E Ben White Blvd
Austin, TX 78741
(512) 462-5815
Circle No 526

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated net list.
ACCEPTABLE: Layout generated by customer's software.
DISCOURAGED: Functional block diagram, unsimulated schematic, layout generated by vendor's software, PG tapes.

DESIGN TOOLS
Customers use LDS software for schematic capture, simulation, timing analysis, layout, and test-program generation.

WORKSTATION SUPPORT
Daisy, Mentor, Valid, IBM PC.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: (Bipolar arrays) Logic design and simulation, timing analysis, test-pattern generation, and (optionally) placement and routing.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: (CMOS arrays) Logic design, simulation, test-program generation, and checking.
VENDOR PERFORMS: Placement and routing, network-equivalence check, and post-layout simulation.

TRAINING
COURSE: You can attend a 4-day course in Austin, TX. Other training performed on individual basis.
DOCUMENTATION: Design manuals available; no commitment necessary.

SUPPORT FACILITIES
Austin, TX and Sunnyvale, CA.

CYCLE TIMES
DESIGN: 1 to 3 weeks, CMOS; 4 to 6 weeks, bipolar.
PROTOTYPING: 5 to 8 weeks, CMOS; 4 to 6 weeks, bipolar.

INPUTS FOR COST ESTIMATE
Array and package type, volume, schedule, temperature range, screening requirements.

ALTERNATE SOURCES
CMOS: LSI Logic

Applied Micro Circuits Corp
5502 Oberlin Dr
San Diego, CA 92121
(619) 450-9333
Circle No 527

CUSTOMER/VENDOR INTERFACE
PREFERRED: Converted net list with vectors, circuit specification, and logic diagrams.

DESIGN TOOLS
Macromatrix design kit includes engineering-rules and design-rules checking, front annotation, and test-program formatting.

WORKSTATION SUPPORT
Mentor, Daisy, Valid, Tektronix/CAE, and Tegas 5 simulator.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Schematic capture, simulation, and test-vector generation.
CUSTOMER PERFORMS USING OWN OR VENDOR'S TOOLS: Engineering- and design-rule checks, net-list generation, front-annotation calculation.
VENDOR PERFORMS: Layout, fault grading.

FUNCTION LIBRARIES
Q1500 Series ECL: Library includes 125 functions built from as many as 750 gates; users can define new functions using existing library elements; simulation parameters include ID, SUH, PD, FO.
Q700 Series ECL: Library includes 115 functions built from as many as five 2-input gates; users can define new functions using existing library elements; simulation parameters include ID, SUH, PD, and FO.

TRAINING
COURSE: A 5-day session is available in San Diego, CA; no design commitment needed.
DOCUMENTATION: Design manuals and application notes are available before design commitment.

SUPPORT FACILITIES
San Diego, CA.

CYCLE TIMES
DESIGN: 2 to 5 weeks.
PROTOTYPING: 5 to 8 weeks.

INPUTS FOR COST ESTIMATION
Logic schematics, product specifications, quantities, and delivery schedules.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
Signetics Corp and Thomson CSF; alternate sourcing effected through PG-tape transfer.

Array Technology
1297 Parkmoor Ave
San Jose, CA 95126
(408) 297-3333
Circle No 528

CUSTOMER/VENDOR INTERFACE
PREFERRED: Schematic or logic diagram.
DISCOURAGED: Net list.

DESIGN TOOLS
CAE software provides schematic-capture, net-list generation, simulation, layout, and Fairchild-Sentry test-program-generation capabilities. CAE access occurs through alphanumeric terminals.

WORKSTATION SUPPORT
Mentor Graphics.

DESIGN CYCLE
CUSTOMER PERFORMS USING VENDOR'S TOOLS. All logic design, simulation, test-program generation, and layout tasks.
VENDOR PERFORMS: Logic minimization, custom cell creation; any other steps at customer's option.

FUNCTION LIBRARIES
Library contains 74 functions built from as many as 47 2-input gates; users can define new functions using existing library elements or discrete gates; all elements have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

TRAINING
COURSE: A 5-day session is included in design fees; course is offered in San Jose, CA.
DOCUMENTATION: Design manuals are available upon design commitment.

SUPPORT FACILITIES
San Jose, CA.

CYCLE TIMES
DESIGN: 6 to 12 weeks.
PROTOTYPING: 3 weeks.

INPUTS FOR COST ESTIMATION
Gate count and package type.

PRODUCTION COMMITMENTS
Nonrecurring engineering charge is lower with design commitment.

ALTERNATE SOURCES
NCR Corp; alternate sourcing effected through PG-tape transfer.

AT&T Technologies
1 Oak Way, Rm 2WC-106
Berkeley Heights, NJ 07922
(800) 372-2447
Circle No 529

DESIGN TOOLS
AT&T CAD software performs circuit analysis over nominal and worst-case processing and temperature parameters.

WORKSTATION SUPPORT
AT&T.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Complete specifications.
VENDOR PERFORMS: Technology-compatibility study, circuit analysis, and layout.

CYCLE TIMES
DESIGN: 1 to 2 months.
PROTOTYPING: 1 to 2 months.

INPUTS FOR COST ESTIMATION
Technology, chip size, package, volume, QA requirements.

Barvon Research Inc
1992 Tarob Ct
Milpitas, CA 95035
(408) 262-8368
Circle No 530

CUSTOMER/VENDOR INTERFACE
PREFERRED: Layout data generated by vendor's software.
ACCEPTABLE: Functional block diagram, simulated or unsimulated schematic or net list, layout data generated by customer's tools, PG tapes.

DESIGN TOOLS
Barvon provides tools accessible through timesharing on Control Data Corp's Cybernet; internal tools support cell compaction for chip-size reductions to 45%.

WORKSTATION SUPPORT
Apollo, Metheus, Valid, and Mentor workstations; layout data includes cell outlines only; internal cell data available after contract negotiation.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, functional simulation.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Logic design.
VENDOR PERFORMS: All simulation, testability-analysis, test-program design, and post-layout analysis functions.

FUNCTION LIBRARIES
Library contains functions built from as many as 180 2-input gates; users can define new functions based on existing library elements; 85% of library cells have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

TRAINING
COURSE: A 3-day course is available in San Jose, CA prior to design commitment; $1000.
DOCUMENTATION: Manuals available before design commitment; $500, updated monthly.

SUPPORT FACILITIES
Santa Clara, CA.

CYCLE TIMES
DESIGN: 2 to 3 weeks.
PROTOTYPING: 5 to 6 weeks.

INPUTS FOR COST ESTIMATION
Gate count, memory requirements.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
None.

California Devices Inc
1051 S Milpitas Blvd
Milpitas, CA 95035
(408) 945-5000
Circle No 531

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list using vendor's macrocells.

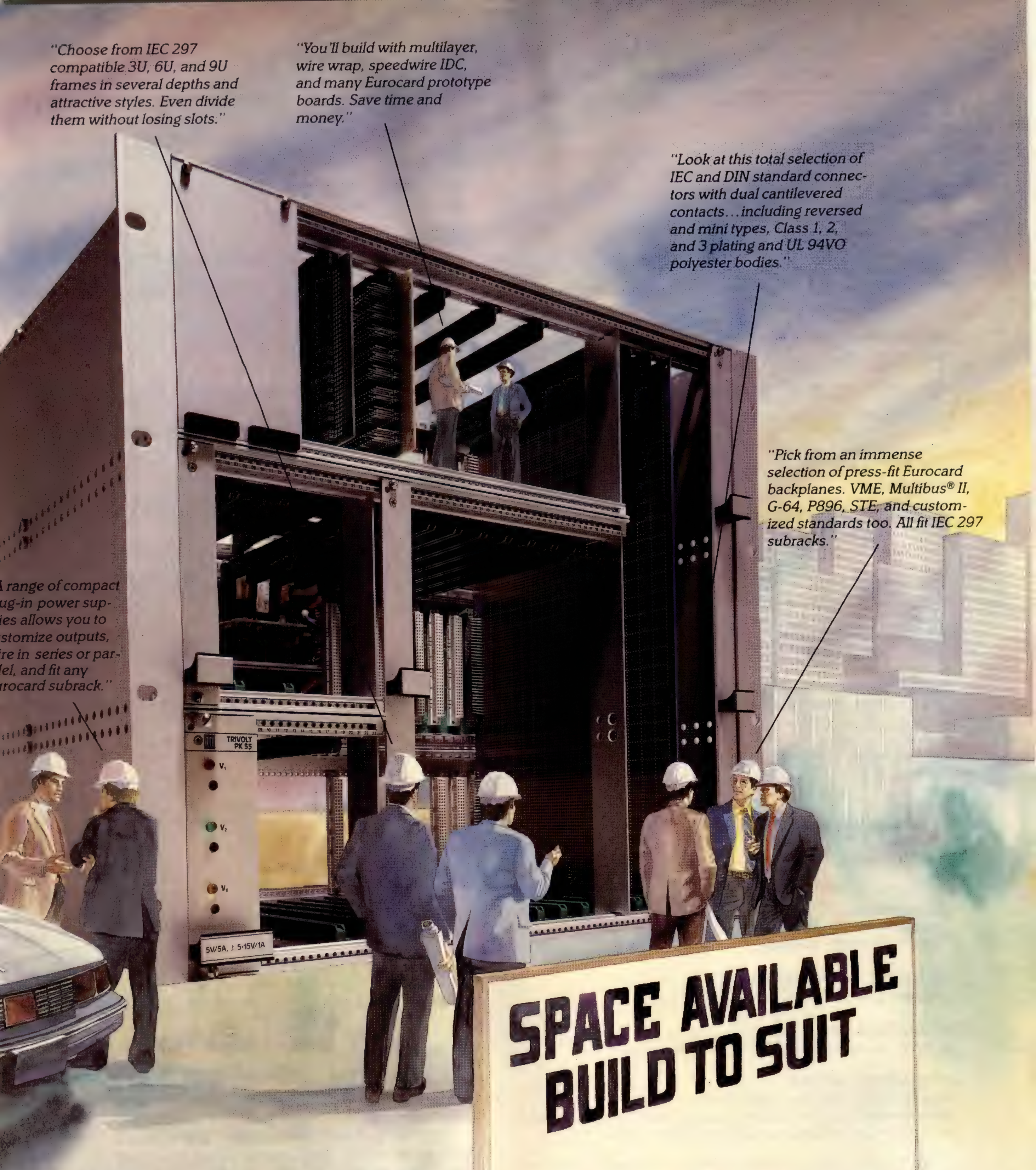
DESIGN TOOLS
CDI uses Hilo-3, SC MEDS, and Maskap V for simulation, physical design, and verification; design system runs on DEC VAX minicomputers.

WORKSTATION SUPPORT
Daisy, Mentor, Valid, and Tektronix/CAE.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, logic design and simulation, timing analysis, testability analysis, placement and routing, network-equivalence check, and post-routing simulation.
CUSTOMER PERFORMS USING OWN OR VENDOR'S TOOLS: Above plus test-pattern generation and custom-cell creation.
VENDOR PERFORMS: Any design step at customer's option.

FUNCTION LIBRARIES
Library includes 200 functions built from as many as 208 2-input gates; users can define new functions using existing library elements or discrete gates; 100% of library cells have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, FI, and FO.

TRAINING
COURSE: Four courses range from 1 to 5 days.
DOCUMENTATION: Design manuals available prior to design commitment.



"Choose from IEC 297 compatible 3U, 6U, and 9U frames in several depths and attractive styles. Even divide them without losing slots."

"You'll build with multilayer, wire wrap, speedwire IDC, and many Eurocard prototype boards. Save time and money."

"Look at this total selection of IEC and DIN standard connectors with dual cantilevered contacts...including reversed and mini types, Class 1, 2, and 3 plating and UL 94VO polyester bodies."

"Pick from an immense selection of press-fit Eurocard backplanes. VME, Multibus® II, G-64, P896, STE, and customized standards too. All fit IEC 297 subracks."

*A range of compact
ug-in power sup-
ies allows you to
stomize outputs,
re in series or par-
lel, and fit any
rocard subrack."*

BICC-VERO packaging is specifically chosen for some of the world's most successful electronic systems. No matter what your plan calls for, we can build to suit.

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FAX: (203) 372-6224/TWX: 510-227-8890

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BICC ELECTRONICS

CIRCLE NO 81

SUPPORT FACILITIES
San Jose, CA and Boston, MA. Dallas, TX and Los Angeles, CA centers opening in 1986.

CYCLE TIMES
DESIGN: 1 to 8 weeks.
PROTOTYPING: 3 weeks.

INPUTS FOR COST ESTIMATION
Gate and pin count, operating temperature and voltage range, I/O specifications, screening requirements.

PRODUCTION COMMITMENTS
None.

Cherry Semiconductor Corp
2000 S County Trail
East Greenwich, RI 02818
(401) 885-3600
Circle No 532

CUSTOMER/VENDOR INTERFACE
PREFERRED: Logic schematic, system definition and block diagram, IC schematic.

DESIGN TOOLS
Applicon AGS, Pspice, IS-Spice.

WORKSTATION SUPPORT
Applicon 860 and 870.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, logic design, simulation, timing analysis, logic minimization, critical-path analysis.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Layout.
VENDOR PERFORMS: Integration and packaging.

TRAINING
COURSE: None offered.

SUPPORT FACILITIES
None.

CYCLE TIMES
DESIGN: 12 to 15 weeks.
PROTOTYPING: 14 weeks.

INPUTS FOR COST ESTIMATION
Estimated gate complexity, packaging, pin count.

PRODUCTION COMMITMENTS
Depends on vendor's involvement in design process.

ALTERNATE SOURCES
Genesis 1200, 1300, and 1400: Exar;
Other arrays: Exar, Ferranti/Interdesign, MCE Semiconductor; alternate sourcing effected through layout-data transfer.

Circuit Technology Inc
160 Smith St
Farmingdale, NY 11735
(516) 293-8686
Circle No 533

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list.
DISCOURAGED: Black-box specification.

DESIGN TOOLS
CTI's CAE system contains cell libraries, automatic layout, network-equivalency checks, and automatic test-program generation. Tools include Hilo-2 and Hilo-3, Cadisys, and Cadigraph in addition to the Applicon AGS860 and NCA software.

WORKSTATION SUPPORT
Mentor, Daisy, Silvar-Lisco.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, functional simulation, logic design, logic simulation.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Above plus testability analysis, timing analysis, fault grading.
VENDOR PERFORMS: Placement and routing, custom-cell creation, network-equivalence check, and post-routing simulation.

FUNCTION LIBRARIES
Library includes more than 100 functions built from as many as 66 2-input gates; users can define new functions based on existing library elements or discrete gates; all elements have been built and tested; simulation parameters include ID, LD, SUH, FI, and FO.

TRAINING
COURSE: 12 courses available with documentation.
DOCUMENTATION: Design manuals available without design commitment; $250.

SUPPORT FACILITIES
Farmingdale, NY. Maroni facilities in Wembley, UK.

CYCLE TIMES
DESIGN: 3 weeks typ.
PROTOTYPING: 10 weeks.

INPUTS FOR COST ESTIMATION
Schematics, electrical specifications, environmental specifications, packaging, and screening requirements.

PRODUCTION COMMITMENT
None.

Custom Integrated Circuits
5343 Wayzata Blvd
Minneapolis, MN 55416
(612) 542-1115
Circle No 534

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list.
ACCEPTABLE: Functional block diagram, unsimulated schematic or net list, layout data, PG tapes.

WORKSTATION SUPPORT
Layout data available for Calma CAD systems and systems running Logcap or Tegas software.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, block-level functional simulation, logic design and simulation, timing analysis, logic-fault grading, test-program generation, custom cell creation, network-equivalency check, post-routing simulation, and timing routing.
VENDOR PERFORMS: Array routing.

FUNCTION LIBRARY
I^2L: Library includes 35 cells built from as many as 300 2-input gates; users can define new functions using existing library elements or discrete gates; 90% of library cells have been built and tested; simulation parameters include ID, LD, VS, TS, PD, FI, and FO.
CMOS: Library includes 50 cells built from as many as 400 2-input gates; users can define new functions using existing library elements or discrete gates; 90% of library cells have been built and tested; simulation parameters include ID, LD, SUH, PD, FI, and FO.

Continued on pg 139

TRAINING
COURSE: None offered.

SUPPORT FACILITIES
Custom Integrated Circuits maintains a design center in Minneapolis, MN.

CYCLE TIMES
DESIGN: 4 to 20 weeks.
PROTOTYPING: 4 to 8 weeks.

INPUTS FOR COST ESTIMATION
Specifications.

PRODUCTION COMMITMENTS
None required.

Custom MOS Arrays Inc
211 Topaz St
Milpitas, CA 95035
(408) 946-9111
Circle No 535

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list with test vectors.
ACCEPTABLE: Unsimulated schematic or net list, layout generated by vendor's software, PG tapes.

WORKSTATION SUPPORT
Valid, Daisy, Tektronix/CAE.

DESIGN CYCLE
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Partitioning analysis, functional simulation, logic design.
VENDOR PERFORMS: Logic design and simulation, timing analysis, testability analysis, test-program generation, fault analysis, all subsequent physical-design tasks.

FUNCTION LIBRARY
Library includes 275 functions built from as many as 1000 2-input gates; users can build new functions based on existing library elements or discrete gates; all elements have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

TRAINING
COURSE: A 5-day course is available.
DOCUMENTATION: Design manuals are available.

CYCLE TIMES
DESIGN: 2 to 12 weeks.
PROTOTYPING: 2 to 6 weeks.

INPUTS FOR COST ESTIMATION
Package type, gate count, screening-test requirements, production volumes.

PRODUCTION COMMITMENTS
None.

Custom Silicon Inc
600 Suffolk St
Lowell, MA 01854
(617) 454-4600
Circle No 536

CUSTOMER/VENDOR INTERFACE
PREFERRED: Block diagrams, net lists.

DESIGN TOOLS
Schematic capture, net-list generation, simulation, layout, and test-program generation.

WORKSTATION SUPPORT
Daisy, Mentor.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Specification, logic design, schematic capture, simulation, and test-program generation.
CUSTOMER PERFORMS ON VENDOR'S TOOLS: Schematic capture, simulation, and test-program generation.
VENDOR PERFORMS: Partitioning, schematic capture, simulation, test-program generation, and physical design.

TRAINING
COURSE: On individual basis.
DOCUMENTATION: Manuals available.

SUPPORT FACILITIES
Boston, MA; Vancouver, WA; Bellevue, WA; and Worthington, OH.

CYCLE TIMES
DESIGN: 4 to 9 weeks.
PROTOTYPING: 5 to 7 weeks.

INPUTS FOR COST ESTIMATION
Circuit and system functions, gate count, ac requirements, dc requirements, and packaging.

PRODUCTION COMMITMENTS
None.

Data Linear Corp
11211 Prosperty Farms Rd
Palm Beach Gardens, FL 33410
(305) 694-0050
Circle No 537

CUSTOMER/VENDOR INTERFACE
ACCEPTABLE: Functional block diagram, simulated or unsimulated schematic or net list, layout data, PG tapes.

DESIGN TOOLS
Data Linear's design system supports analog simulation.

WORKSTATION SUPPORT
VIA Systems, DEC VAX. Cell outlines for layout on Calma, VIA, and Applicon CAD systems.

DESIGN CYCLE
CUSTOMER PERFORMS USING VENDOR TOOLS: Partitioning analysis, functional simulation, circuit simulation, timing analysis, post-routing simulation.
VENDOR PERFORMS: Test-program generation, testability analysis, chip routing, custom cell creation, network-equivalency check.

TRAINING
COURSE: A 10-day session is available in Palm Beach, FL after design commitment; $1000.
DOCUMENTATION: Manuals available without design commitment; $250; updated quarterly.

SUPPORT FACILITIES
None maintained.

CYCLE TIMES
DESIGN: 2 to 3 weeks.
PROTOTYPING: 8 to 10 weeks.

INPUTS FOR COST ESTIMATION
Preliminary schematic.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
None.

Electronic Technology Corp
2037 North Towne Lane NE
Cedar Rapids, IA 52402
(319) 395-0567
Circle No 538

CUSTOMER/VENDOR INTERFACE
PREFERRED: Functional block diagram, schematic.

DESIGN TOOLS
Simulation, Spice analysis, automatic routing, and design-rule checking.

WORKSTATION SUPPORT
Daisy, Mentor, and Calma GDS I and II.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, functional simulation, logic design and simulation, timing analysis, critical-path analysis, and test-program generation.
CUSTOMER PERFORMS ON VENDOR'S TOOLS: All of above plus placement, routing, and network-equivalence check.
VENDOR PERFORMS: Custom-cell generation and PG-tape conversion.

TRAINING
COURSE: 2-day course in Cedar Rapids, IA.
DOCUMENTATION: Available.

SUPPORT FACILITIES
Cedar Rapids, IA and Chicago, IL.

CYCLE TIMES
DESIGN: 1 to 3 weeks.
PROTOTYPING: 5 to 7 weeks.

INPUTS FOR COST ESTIMATION
Preliminary diagram, gate count, packaging, and volume.

PRODUCTION COMMITMENTS
None.

Exar Corp
750 Palomar Ave
Sunnyvale, CA 94088
(408) 732-7970
Circle No 539

CUSTOMER/VENDOR INTERFACE
PREFERRED: For digital arrays, schematic or net list. For linear arrays, completed layout design on hook-up sheets.

DESIGN TOOLS
Simulation tools on VAX 8600 computer.

WORKSTATION SUPPORT
Daisy.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, logic design and simulation, testability analysis, and test-pattern generation.
VENDOR PERFORMS: Above steps at customer's option, placement and layout, design verification.

TRAINING
COURSE: None.
DOCUMENTATION: Design manuals available prior to design commitment; $59.

SUPPORT FACILITIES
Design center in England.

CYCLE TIMES
DESIGN: 4 to 6 weeks.
PROTOTYPING: 6 weeks.

INPUTS FOR COST ESTIMATION
Schematic, packaging, test parameters, and production volume.

PRODUCTION COMMITMENTS
25,000 units.

ALTERNATE SOURCES
All products: R-Ohm, mask transfer.
Linear products except V100, X100, W100, and XR400: Ferranti Interdesign, layout-data transfer.
I^{2}L products: Cherry Semiconductor, layout-data transfer.

Fairchild Camera and Instrument Corp
1801 McCarthy Blvd
Milpitas, CA 95035
(408) 942-2522
Circle No 540

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list.
ACCEPTABLE: Unsimulated schematic or net list.
DISCOURAGED: Functional block diagram, layout data generated by customer's software, PG tapes.

DESIGN TOOLS
Fairchild's technology-independent CAE system supports schematic entry, database creation, simulation, testability analysis, automatic layout, and post-routing analysis. Users connect to the system using alphanumeric or high-resolution graphics terminals. You can lease Fairchild's design system to run on your MicroVAX or other VMS computer.

WORKSTATION SUPPORT
Mentor, Daisy, Valid, and Futurenet; cell-outline data available for Silvar-Lisco layout systems; internal cell data is available upon nondisclosure agreement.

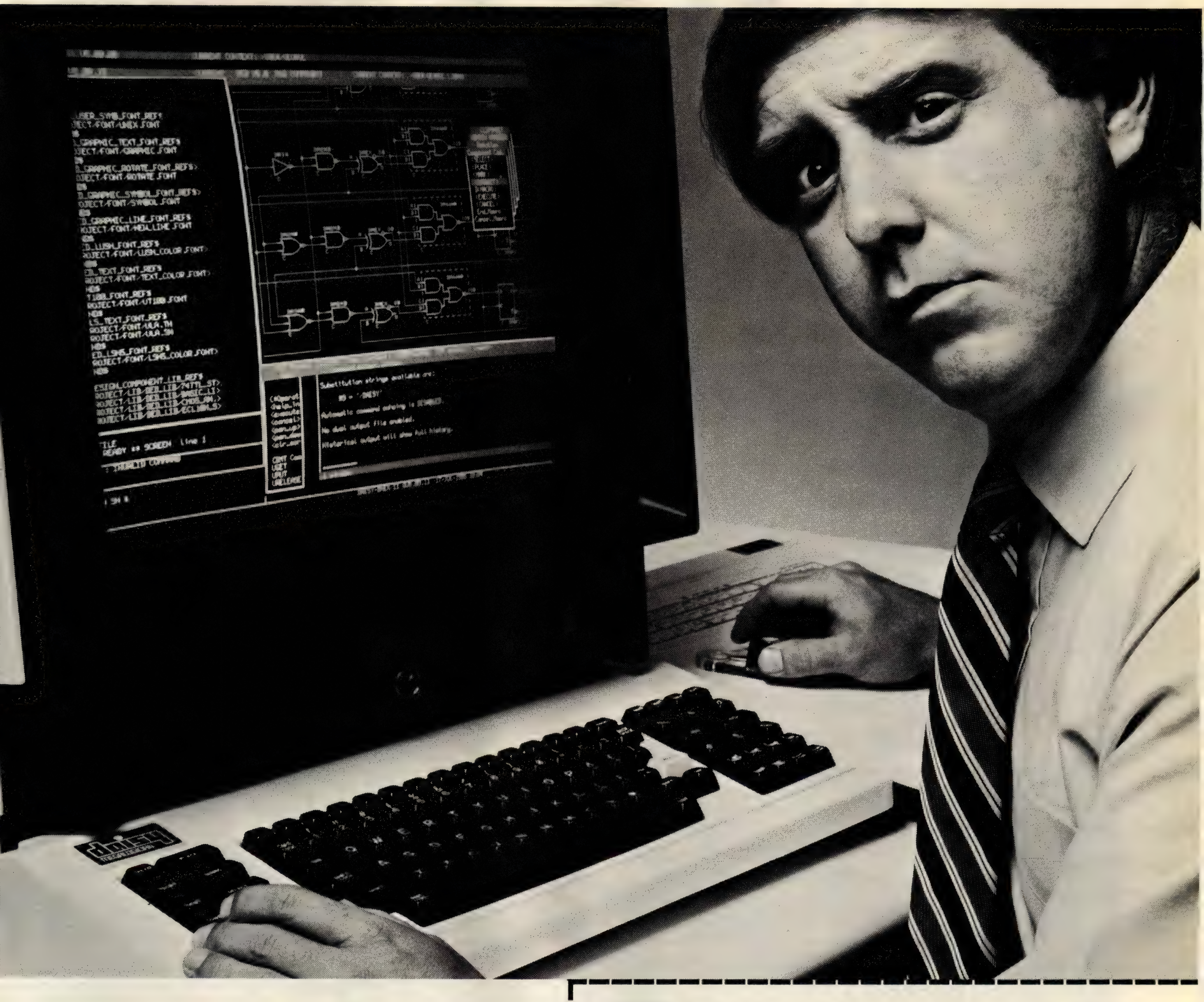
DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, block-level functional simulation, logic minimization, test-program generation, testability analysis.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Logic design, simulation, timing and critical-path analysis, testability analysis, fault grading, interactive or automatic routing, post-routing simulation.
VENDOR PERFORMS: Custom cell creation.

FUNCTION LIBRARIES
ECL: Library includes 60 functions built from as many as 60 2-input cells, users can define new functions using existing library elements; half of all library cells have been built and tested; simulation parameters include ID, LD, PD, FI, FO, and process sensitivity.
CMOS: Library includes 65 cells built from as many as 100 gates; users can define new functions based on existing elements; 50% of the library has been fabricated and tested; simulation parameters include ID, LD, SUH, PD, FI, FO, and process sensitivity.

TRAINING
COURSE: A 2-day course ($300) in ECL design and a 1-day course ($200) in CMOS design are available at Fairchild's gate-array design centers.

Continued on pg 144

Now 2 microns are smaller than 1.5 microns.



Here's why.

CDI's channelless ASIC technology gives you more performance in less silicon space. So at 2 microns, you get more speed and smaller die size than you'd expect from a 1.5 micron circuit. Or at 3 microns, you get economical 2 micron equivalent speed and size.

With proven producibility, too.

And when you want to move from semicustom into standard cells, CDI reduces conversion risk, too—with the only software that doesn't require you to re-engineer or resimulate your design.

Write or call CDI for complete information today. And find out why less is more.

CIRCLE NO 83

CDI CALIFORNIA DEVICES INC.

EDN 030686

California Devices, Inc.
Attention: Marketing Services Data
2201 Qume Drive, San Jose, CA 95131.
Telephone (408) 945-5026.

I WANT TO KNOW WHY LESS IS MORE.

☐ Please send me information on your channelless semicustom technology.

☐ Please send me information on your channelless standard cell technology.

Name ____________________

Title ____________________

Company ____________________

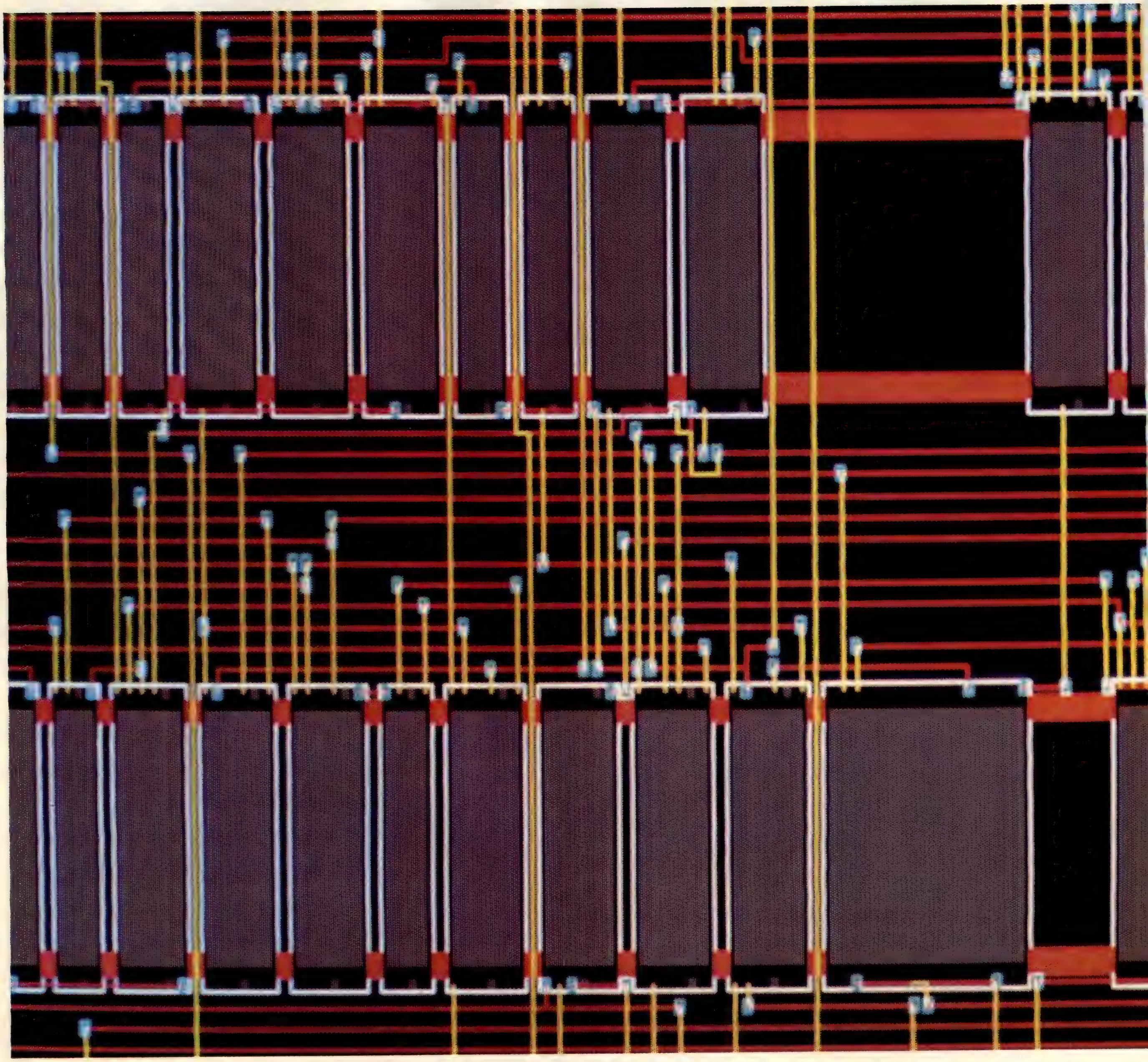
Address ____________________

City ____________________

State __________ Zip __________

Telephone ____________________

In semicustom CAE, only Mentor Graphics knows how to get around the block.



If you're responsible for logic design, chances are that silicon implementation is not near and dear to your heart.

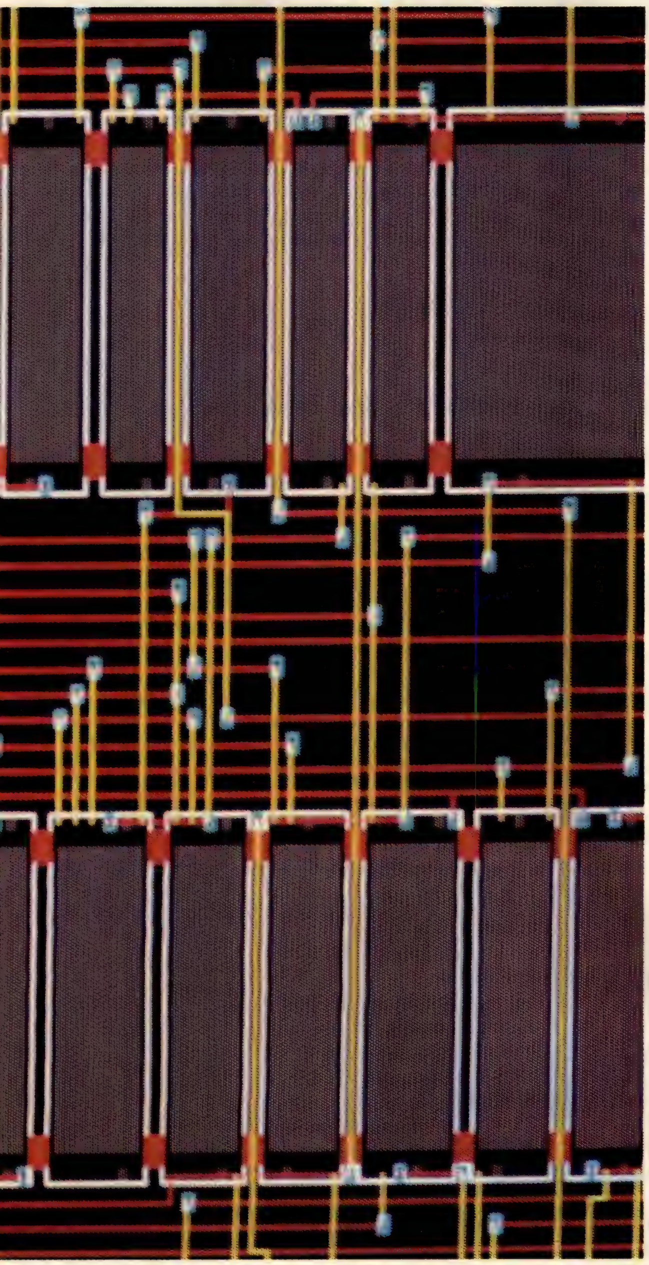
But *somebody's* got to do it, right?

Wrong.

If you're working with standard cells or gate arrays, there is now a CAE system that can do it for you.

The IDEA Series™ from Mentor Graphics.

The impact on your productivity? Just short of staggering. Months of layout work compressed into hours. 98 to 100 per cent of the layout task completed without human intervention.



At the heart of this landmark achievement are automatic placement and automatic routing algorithms unique to Mentor Graphics.

No one does it better. Or faster.

Imagine. A 2400-gate design placed and routed in just 3 hours, 15 minutes. Completely and automatically. With 95% gate utilization.

Even after the routing and placement puzzle is solved, Mentor Graphics superior intelligence stays with you. Every move you make during cleanup work is monitored by the system to ensure you stick to the layout rules. You're even presented with legal alternatives to head off mistakes before you make them.

And to top it off, the wire delay values produced during the layout can be back-annotated into the original logic design for super-accurate simulations.

Consider the big picture, too. With the IDEA Series, you have a complete set of integrated engineering tools that come into play long before layout. A fully integrated path all the way from schematic entry to simulation to layout to prototype verification.

You design faster, better and less expensively.

It's all part of a vision unique to Mentor Graphics, the technological leader in Computer-Aided Engineering. Let us show you where this vision can take you.

Reading, England; Phone 0734-884888; Telex 851849975
Munich, West Germany; Phone 089-319-1003; Telex 8415214474
Wiesbaden, West Germany; Phone 612-137-1021 **The Hague, Netherlands;** Phone (70) 654507; Telex 31792 **Paris, France;** Phone (1).560.51.51; Telex 842270809 **Milan, Italy;** Phone 02-824-4161; Telex 843340422 **Tokyo, Japan;** Phone 03-589-2834; Telex 7812422573 **Singapore;** Singapore Science Park
Middle East, Far East, Asia; Phone 503-626-7000; Telex 4742102

Mentor Graphics™

DOCUMENTATION: Design manuals are available upon design commitment.

SUPPORT FACILITIES
Milpitas, CA; Waltham, MA; Santa Ana, CA; Richardson, TX; Bloomington, MN; Tokyo, Japan; and Reading, UK.

CYCLE TIMES
DESIGN: 1 to 2 weeks.
PROTOTYPING: 6 to 8 weeks.

INPUTS FOR COST ESTIMATION
Approximate gate count, device type, production volume, screening requirements.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
ECL arrays: Signetics Corp; alternate sourcing effected through PG-tape transfer.

Ferranti Interdesign Inc
1500 Green Hills Rd
Scotts Valley, CA 95066
(408) 438-2900
Circle No 541

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic, truth tables and timing diagrams, transistor-level schematic for linear arrays, breadboard for linear/digital arrays.
DISCOURAGED: Functional block diagram, unverified design.

DESIGN TOOLS
Proprietary design system runs on VAX and performs functional and dynamic simulation. Front-end design is possible on IBM PCs and Mentor workstations. Applicon systems and ECAD software support back-end design.

WORKSTATION SUPPORT
Digital arrays: Futurenet, Mentor. **Bipolar digital and linear arrays:** Mentor, Daisy, Valid. **Linear arrays:** Analog Workbench.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, schematic capture.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Logic design, timing analysis, critical-path analysis, testability analysis, test-pattern generation, custom cell creation, interactive layout of some arrays.
VENDOR PERFORMS: All simulations, chip layout and post-layout analysis; any design or simulation steps at user's option.

FUNCTION LIBRARY
Each library contains as many as 65 SSI functions; users can define new functions using existing library elements or discrete gates; simulation parameters include ID, LD, TS, VS, PD, FI, and FO.

TRAINING
DOCUMENTATION: MMK Design Manual is available prior to design commitment; $99.

SUPPORT FACILITIES
Scotts Valley, CA and Commack, NY.

CYCLE TIMES
DESIGN: 4 to 8 weeks, depending on vendor involvement.
PROTOTYPING: 4 to 8 weeks.

INPUTS FOR COST ESTIMATION
Schematic, circuit and I/O specifications, packaging, temperature range, and testing requirements.

PRODUCTION COMMITMENTS
500 pieces/year required or preferred, depending on array type.

ALTERNATE SOURCES
MC and MO Series: MCE Semiconductors and Exar; alternate sourcing effected through layout-data transfer.
MP Series: GTE Microcircuits; alternate sourcing effected through mask, PG tape, layout-data, or net-list transfer.

Fujitsu Microelectronics Inc
3200 Scott Blvd
Santa Clara, CA 95054
(408) 727-1700
Circle No 542

CUSTOMER/VENDOR INTERFACE
ACCEPTABLE: Unsimulated schematic or net list; simulated schematic or net list. Designs in Tegas format also accepted.
DISCOURAGED: Functional block diagram, layout data, PG tapes.

DESIGN TOOLS
Fujitsu releases the specifications for its high-level language (FLDL) that accommodates circuit descriptions compatible with in-house simulation and layout tools; users create FLDL files using any text editor and transmit files to Fujitsu on block-format 1600-bps magnetic tapes. The firm also offers a test-description language (FTDL) for test-program transfers. Fujitsu routes all arrays automatically using mainframe-based tools.

WORKSTATION SUPPORT
Daisy, Valid, and Mentor.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Logic capture, simulation.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Functional simulation, logic simulation, test-program generation.
VENDOR PERFORMS: Timing analysis, all layout and post-layout analysis steps.

FUNCTION LIBRARIES
CMOS: Library contains more than 110 functions built from as many as 68 2-input gates; users can define new functions based on existing library elements; all functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, FI, and FO.
Bipolar: Library contains 96 functions built from as many as 120 2-input gates plus 70 74LS-equivalent elements; users can define new functions based on existing library elements; all functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, FI, and FO.

TRAINING
COURSE: 3-day course at design center is available at no cost upon design commitment.
DOCUMENTATION: Design evaluation guides are offered at no cost prior to design commitment.

SUPPORT FACILITIES
Santa Clara, CA; Dallas, TX; and Boston, MA.

CYCLE TIMES
DESIGN: 1 to 3 weeks.
PROTOTYPING: 6 to 12 weeks.

INPUTS FOR COST ESTIMATION
Array type, package type, gate count, critical-speed paths.

PRODUCTION COMMITMENTS
Fujitsu prefers a production commitment of at least $100,000 over 2 yrs.

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In the tradition of every Apollo product that's come before, our newest offerings will let technical people work together as teams. More united than ever. Supported by unprecedented power. Able to work in multi-vendor environments.

More importantly, our newest products will establish Apollo as much more than a workstation manufacturer. We'll be a graphics company. A computer company. A total solutions company. With a broader product line and better technology than anyone else in scientific and technical computing.

For more information, call (617) 256-6600 x4889. Or write Apollo, 330 Billerica Rd., Chelmsford, MA 01824, MS 41.

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ALTERNATE SOURCES
Texas Instruments Inc; alternate sourcing effected through PG-tape transfer.

GE Semiconductor
1 Micron Dr
Research Triangle Park, NC 27709
(919) 549-3114
Circle No 543

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated net list.
DISCOURAGED: Unverified schematics, block diagram.

DESIGN TOOLS
CAE software enables all design steps from schematic capture through PG-tape generation on VAX hardware.

WORKSTATION SUPPORT
Daisy, Mentor, Futurenet, and P-Cad.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Schematic capture and simulation.
VENDOR PERFORMS: Layout, post-layout simulation, PG-tape generation.

FUNCTION LIBRARY
Library contains 60 (20,000 Series arrays) and 70 (10,000 Series) hard-wired macros as complex as up/down counters; users can create new cells from discrete gates or build soft macros by combining multiple hard-wired elements; all functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

TRAINING
COURSE: Courses available on gate-array design and design using P-Cad tools.
DOCUMENTATION: Design manuals available.

SUPPORT FACILITIES
San Jose, CA; Research Triangle Park, NC; Portland, OR; New Haven, CT; Basingstoke, UK; Paris, France; Munich, West Germany.

CYCLE TIMES
DESIGN: 2 to 3 weeks.
PROTOTYPING: 5 to 6 weeks.

INPUTS FOR COST ESTIMATION
Gate count, packaging, pin count.

PRODUCTION COMMITMENTS
None required.

General Instrument
Microelectronics Div
600 W John St
Hicksville, NY 11802
(516) 933-3107
Circle No 544

CUSTOMER/VENDOR INTERFACE
PREFERRED: Layout data in Calma format.
ACCEPTABLE: Simulated schematic.
DISCOURAGED: Unsimulated schematic or net list, functional block diagram, PG tapes.

DESIGN TOOLS
GI's CAE system supports data entry, simulation, and automatic routing. The system requires both alphanumeric and graphics terminals and runs on VAX and Prime minicomputers.

WORKSTATION SUPPORT
Daisy, Mentor, and Valid.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN OR VENDOR'S TOOLS: Logic design, simulation, timing anaylsis, test-pattern generation, testability analysis, fault grading, and post-layout simulation.
VENDOR PERFORMS: Placement and routing, custom-cell creation, network-equivalence check. Any other steps at customer's discretion.

FUNCTION LIBRARIES
Library includes 60 functions built from as many as 10 2-input gates; users can define new functions using existing library elements or discrete gates; all library cells have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

TRAINING
COURSE: Training offered in New York and California.
DOCUMENTATION: Design manuals available prior to design commitment; manuals are updated quarterly.

SUPPORT FACILITIES
None maintained.

CYCLE TIMES
DESIGN: 2 to 4 weeks.
PROTOTYPING: 7 to 9 weeks.

INPUTS FOR COST ESTIMATION
Functional description, approximate complexity, package type, special requirements.

PRODUCTION COMMITMENTS
Estimate of 18-month production volumes.

ALTERNATE SOURCES
Plessey and MCE Semiconductors Inc.

GTE Microcircuits Div
2000 W 14th St
Tempe, AZ 85281
(602) 968-4431
Circle No 545

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list.
ACCEPTABLE: Unsimulated schematic or net list, layout data generated by customer's software, PG tapes.
DISCOURAGED: Functional block diagram.

WORKSTATION SUPPORT
Daisy and Mentor.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, functional simulation, logic design.
VENDOR OR CUSTOMER PERFORMS: Logic simulation, timing analysis, logic minimization, test-program generation, testability analysis, fault grading.
VENDOR PERFORMS: Critical-path analysis, chip layout, post-layout analysis.

FUNCTION LIBRARY
Library includes 44 cells built from as many as 10 2-input gates; users can create new cells from existing library elements or discrete gates; 100% of library has been fabricated and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

TRAINING
COURSE: None offered.
DOCUMENTATION: Design manuals are available prior to design commitment; $45; updated yearly.

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The personal power shortage is over. Introducing the Apollo DOMAIN® Series 3000. A family of personal workstations that are priced like PCs, packaged like PCs, easy to use like PCs. Yet they perform with the authority of machines twice the size and three times the price.

Consider their raw power. Despite the fact that DN3000s fit comfortably on the corner of your desk, they have room inside for a 32-bit, virtual memory engine that includes a Motorola 68020 and 68881 floating point chip. Sufficient force to deliver processing speeds that overwhelm the IBM PC.

Their processing proficiency is equalled only by their graphics. A monochrome DN3000 exhibits 1280 x 1024 resolution on a 19-inch monitor. While a color version, with its four-bit planes, displays 16 colors simultaneously on a high-resolution, 15-inch flicker-free screen.

While such qualities alone are cause enough for celebration, the DN3000s were notably designed with an understanding that technical professionals work as much with each other as they do with their workstations.

Hence, like all Apollo workstations, DN3000s inherently let you transparently share information and resources across a high-speed local area network.

An IBM PC/AT®- compatible bus assures the ability to integrate options into the system.

And an open architecture supports such industry standards as UNIX™ and ETHERNET,® providing easy access to computer systems made by IBM® and DEC.®

The DOMAIN Series 3000. In monochrome from under $10,000. In color from under $15,000. Proof that it doesn't take a lot of money to attain a position of power.

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SUPPORT FACILITIES
None maintained.

CYCLE TIMES
DESIGN: 6 to 22 weeks.
PROTOTYPING: 4 to 6 weeks.

INPUTS FOR COST ESTIMATION
Detailed design data.

PRODUCTION COMMITMENTS
Design costs depend on production commitment.

ALTERNATE SOURCES
None.

Gould AMI Semiconductors
3800 Homestead Rd
Santa Clara, CA 95051
(408) 246-0330
Circle No 546

CUSTOMER/VENDOR INTERFACE
PREFERRED: Net list, design database, PG tape, logic diagram.
DISCOURAGED: Functional block diagram.

DESIGN TOOLS
Design tools include simulators, automatic place-and-route software with back annotation, test generation, and design-rule checkers.

WORKSTATION SUPPORT
P-Cad, Viewlogic, Daisy, Mentor, Intergraph, Calma, and Tektronix.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Schematic capture, simulation, test-program generation, and back annotation.
CUSTOMER PERFORMS ON VENDOR'S TOOLS: All of the above.
VENDOR PERFORMS: Custom-cell generation.

FUNCTION LIBRARIES
Library includes 62 functions built from as many as 78 2-input gates; users can define new functions using existing library elements or discrete gates; all functions have been fabricated and tested; simulation parameters include ID, LD, SUH, FI, and FO.

TRAINING
COURSE: 2-day training course available at design centers.
DOCUMENTATION: Available documentation includes user guides, design manuals, data books, training course notes, and application notes.

SUPPORT FACILITIES
Santa Clara, CA; Jericho, NY; Altamonte Springs, FL; Swindon, UK; Graz, Austria; Tokyo, Japan. Design support also available in Pocatello, ID; Salt Lake City, UT; and Santa Clara, CA.

CYCLE TIMES
DESIGN: 10 weeks max.
PROTOTYPING: 6 weeks max.

INPUTS FOR COST ESTIMATION
Gate count, packaging, logic diagram, or net list.

PRODUCTION COMMITMENTS
Minimum shipment, $5000.

Harris Semiconductor Sector
Box 883
Melbourne, FL 32901
(305) 724-7407
Circle No 547

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic.
ACCEPTABLE: Unsimulated schematic, layout data generated by vendor's software.
DISCOURAGED: Functional block diagram, layout data generated by customer's software, PG tapes.

DESIGN TOOLS
Harris offers CAE software over a time-sharing network. One system for both gate-array and standard-cell design supports all phases of chip design, including testability analysis, test-program generation, and post-routing simulation.

WORKSTATION SUPPORT
Daisy and Valid.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, logic design, test-pattern generation.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Above plus logic simulation, timing analysis, testability analysis, fault grading, network-equivalence check, post-routing simulation.
VENDOR PERFORMS: Placement and routing, custom-cell creation.

TRAINING
COURSE: A 5-day course is offered prior to design commitment in Melbourne; $1500.
DOCUMENTATION: Design manuals are available prior to design commitment.

SUPPORT FACILITIES
Melbourne, FL.

CYCLE TIMES
DESIGN: 2 to 4 weeks.
PROTOTYPING: 4 to 6 weeks.

INPUTS FOR COST ESTIMATION
Schematics, production quantity, package type, specifications.

PRODUCTION COMMITMENTS
None.

Holt Inc
8 Chrysler Ave
Irvine, CA 92714
(714) 859-8800
Circle No 548

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated or unsimulated schematic or net list.
ACCEPTABLE: Functional block diagram.
DISCOURAGED: Layout data, PG tapes.

DESIGN CYCLE
VENDOR PERFORMS: All logic-design, simulation, testability-analysis, test-program-generation, and chip-layout steps.

TRAINING
COURSE: None offered.

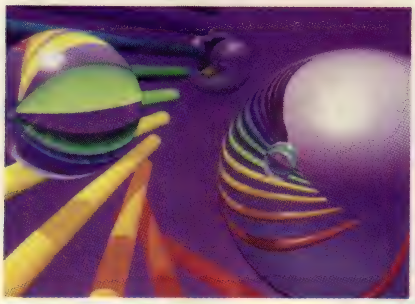
CYCLE TIMES
DESIGN: 4 to 6 weeks.
PROTOTYPING: 3 to 4 weeks.

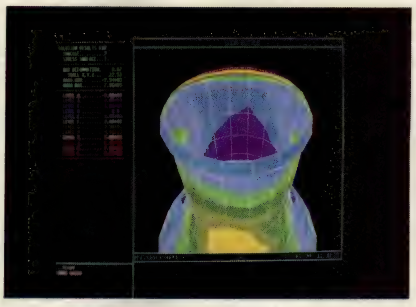
INPUTS FOR COST ESTIMATION
Logic diagram or schematic.

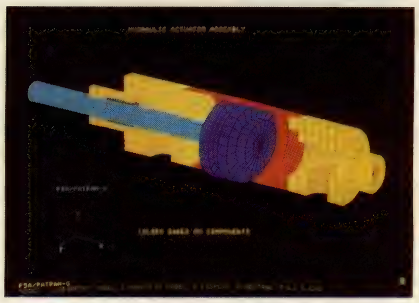
PRODUCTION COMMITMENTS
None required.

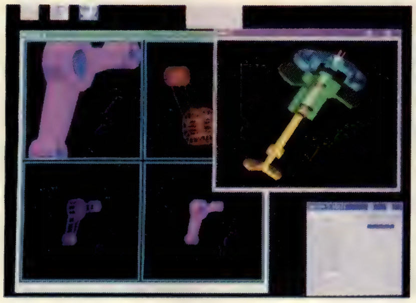
ALTERNATE SOURCES
None.

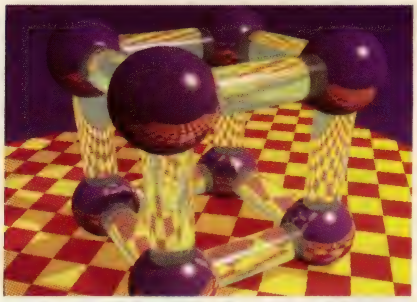
OUR 3D GRAPHICS WORKSTATION IS SO FAST IT'S AMAZING THESE PICTURES AREN'T BLURRED.

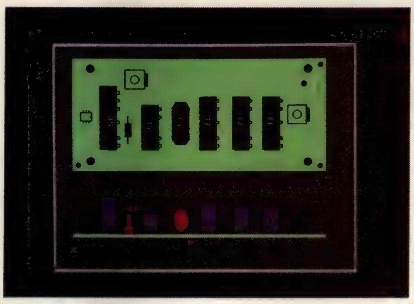


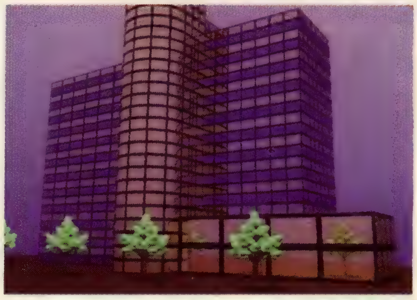












Until now, if you wanted realtime 3D graphics on a powerful workstation, you had only two choices. Both of them a compromise.

You could purchase a specialized graphics workstation but sacrifice a compatible product family, software and application choice. Or you could opt for a reputable engineering workstation and settle for color graphics that could only be labeled dull.

Introducing Apollo's new DN580. It asks no sacrifice. Instead, this powerful 32-bit graphics workstation overwhelms anything that claims to be either graphic or a workstation.

Its powerful graphics pipeline processor performs 3D graphics at an amazing 100,000-plus vectors per second, a record well beyond the reach of any other computer or workstation supplier.

Yet despite such speed, the DN580 complies with PHIGS and supports UNIX,™ dispelling the myth that performance and standards are contradictory terms.

Of course the DN580 offers more than alacrity. As part of an advanced distributed processing network, its speed is greatly enhanced by an ability to access other Apollo workstations. As well as systems made by DEC® and IBM®

And with Apollo's open architecture, you can perform all these stunts with a single system view.

The Apollo DN580. The only thing faster is the rate at which our competitors will have to work to catch up.

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EDN SEMICUSTOM-IC DIRECTORY

Honeywell Digital Products Center
1150 E Cheyenne Mountain Blvd
Colorado Springs, CO 80906
(303) 577-3581
Circle No 549

CUSTOMER/VENDOR INTERFACE

PREFERRED: Simulated schematic or net list, layout data generated using vendor's software, PG tape.

DISCOURAGED: Unsimulated schematic, layout data generated by customer's software, functional block diagram.

DESIGN TOOLS

Vendor's Software Toolkit enhances workstation simulation programs and runs on Mentor workstations. Merlyn-G physical design tools are available for back-end design.

WORKSTATION SUPPORT

Mentor and Daisy.

DESIGN CYCLE

CUSTOMER PERFORMS USING OWN OR VENDOR'S TOOLS: Functional simulation, logic design and simulation, fault grading, test-vector generation.

VENDOR PERFORMS: Placement and routing, network-equivalency check, test-program generation, tooling.

FUNCTION LIBRARIES

CML HT5000 array: Library includes over 75 functions built from as many as 80 2-input gates; users can create new functions based on existing library elements; 100% of library functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

CML HE2000, HM3500 arrays: Library includes over 150 functions built from as many as 70 2-input gates; users can create new functions based on existing library elements; 75% of library functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

TRAINING

COURSE: A 4-day session is available prior to design commitment; course offered in Colorado Springs, CO or at customer sites.

DOCUMENTATION: Manuals available prior to design commitment.

SUPPORT FACILITIES

Minneapolis, MN and Colorado Springs, CO.

CYCLE TIMES

DESIGN: Depends on design complexity.

PROTOTYPING: 8 to 10 weeks.

INPUTS FOR COST ESTIMATION

Gate count, list of functions, package, production volume, and schedule.

PRODUCTION COMMITMENTS

None required.

ALTERNATE SOURCES

HE, HM, HT arrays: Fairchild.

Hughes Aircraft Co
Semiconductor Div
500 Superior Ave
Newport Beach, CA 92658
(714) 759-2727
Circle No 550

CUSTOMER/VENDOR INTERFACE

PREFERRED: Simulated database with test vectors.

DESIGN TOOLS

Vendor supplies proprietary software for workstations; software provides timing simulation and back annotation.

WORKSTATION SUPPORT

Mentor, Daisy, Valid, and IBM PC partially supported.

DESIGN CYCLE

CUSTOMER PERFORMS USING OWN TOOLS: Test-vector generation, fault analysis.

CUSTOMER PERFORMS USING VENDOR'S TOOLS: Schematic capture, logic and timing simulation, back annotation.

VENDOR PERFORMS: Layout, tooling, test-program generation.

TRAINING

COURSE: Training course covers aspects of design cycle.

DOCUMENTATION: Support manuals come with courses.

SUPPORT FACILITIES

Newport Beach, CA.

CYCLE TIMES

DESIGN: 4 to 6 weeks.

PROTOTYPING: 8 to 10 weeks.

INPUTS FOR COST ESTIMATION

Schematic, screening and packaging requirements, volume.

PRODUCTION COMMITMENTS

Negotiable.

ALTERNATE SOURCES

None.

Integrated Circuit Systems Inc
1012 W 9th Ave
King of Prussia, PA 19406
(215) 265-8690
Circle No 551

CUSTOMER/VENDOR INTERFACE

PREFERRED: Simulated schematic.

ACCEPTABLE: Functional block diagram, unsimulated schematic, layout data generated by vendor's software, PG tapes.

DISCOURAGED: Layout data generated by customer's software.

DESIGN TOOLS

The firm's CAE system runs on VAX minicomputers and is accessible through a high-resolution graphics terminal.

WORKSTATION SUPPORT

Mentor, Daisy, and Valid.

DESIGN CYCLE

CUSTOMER PERFORMS USING OWN TOOLS: Logic design.

CUSTOMER PERFORMS USING VENDOR'S TOOLS: Functional and logic simulations, timing analysis, test-pattern generation, post-routing simulation.

VENDOR PERFORMS: Partitioning analysis, testability analysis, fault grading, placement and routing, custom cell creation, network-equivalency check.

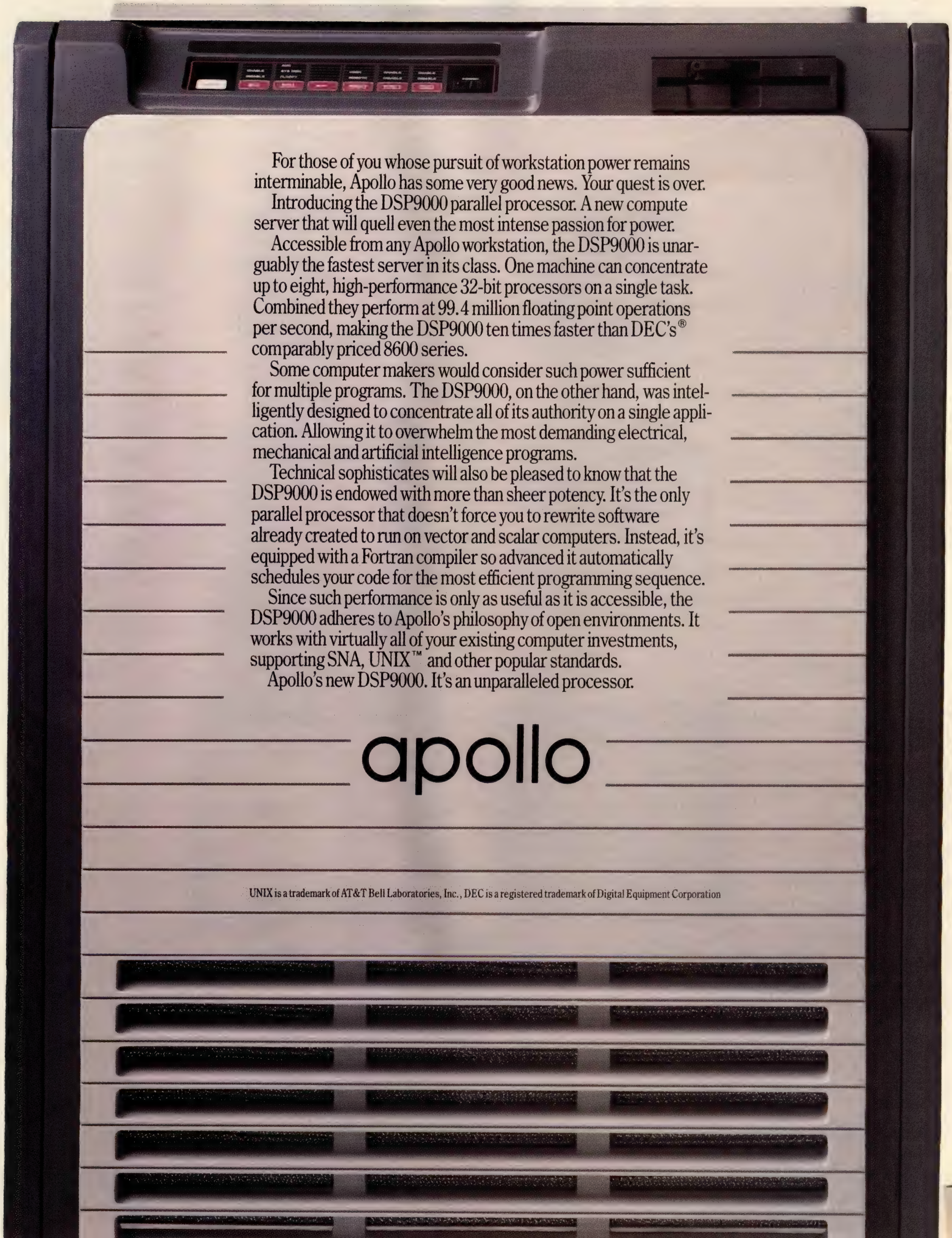
TRAINING

COURSE: Training is available prior to design commitment.

DOCUMENTATION: Design manuals are free; available prior to design commitment; updated semiannually.

Continued on pg 159

APOLLO INTRODUCES A PARALLEL PROCESSOR THAT HAS NO PARALLEL.



For those of you whose pursuit of workstation power remains interminable, Apollo has some very good news. Your quest is over.

Introducing the DSP9000 parallel processor. A new compute server that will quell even the most intense passion for power.

Accessible from any Apollo workstation, the DSP9000 is unarguably the fastest server in its class. One machine can concentrate up to eight, high-performance 32-bit processors on a single task. Combined they perform at 99.4 million floating point operations per second, making the DSP9000 ten times faster than DEC's® comparably priced 8600 series.

Some computer makers would consider such power sufficient for multiple programs. The DSP9000, on the other hand, was intelligently designed to concentrate all of its authority on a single application. Allowing it to overwhelm the most demanding electrical, mechanical and artificial intelligence programs.

Technical sophisticates will also be pleased to know that the DSP9000 is endowed with more than sheer potency. It's the only parallel processor that doesn't force you to rewrite software already created to run on vector and scalar computers. Instead, it's equipped with a Fortran compiler so advanced it automatically schedules your code for the most efficient programming sequence.

Since such performance is only as useful as it is accessible, the DSP9000 adheres to Apollo's philosophy of open environments. It works with virtually all of your existing computer investments, supporting SNA, UNIX™ and other popular standards.

Apollo's new DSP9000. It's an unparalleled processor.

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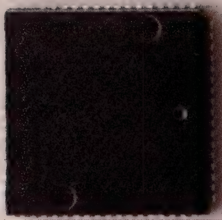
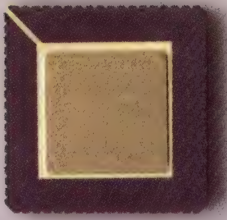
ASIC.

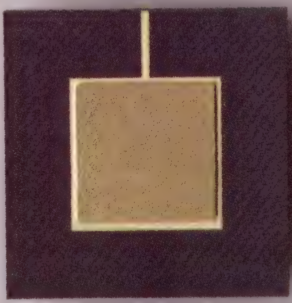


LL 3000 Series Gate Array
3.5 μ, 1-Layer Metal

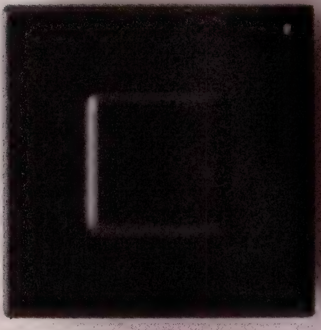


LL 5000 Series Gate Array
3 μ, 2-Layer Metal

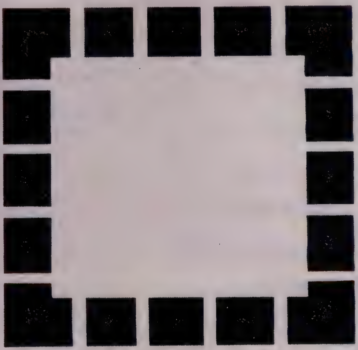
LL 7000 Series Gate Array
2 μ, 2-Layer Metal



LL 8000 Series Gate Array
2 μ, 2-Layer Metal



LSA 2000 Series Structured Array
2 μ, 2-Layer Metal



6 to 10 weeks

ASAP.

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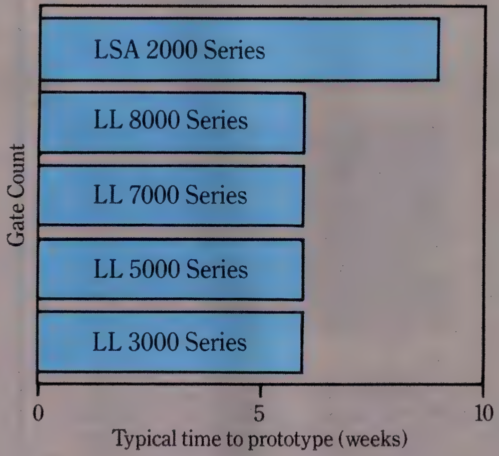
And you need it fast.

An Application-Specific Integrated Circuit. From LSI Logic.

Start with gate arrays in 2- or 3-micron HCMOS, single or double metal technologies. Up to 10,000 gates. And go from simulation sign-off to prototypes in just 6 weeks.

Or move up to more complex designs with structured arrays. In only 8 to 10 weeks.

And do it easily. With our proprietary LDS™ Design System. Which lets you design, simulate, verify and generate test sequences. Fast.



Right in your office, on your workstation. Or at any of our 10 design centers, worldwide.

Where our experts guide you every step of the way, right to prototype and production. In the industry's most advanced production facilities. All here in the U.S.A. So you lose nothing in transit. Or translation.

To get your edge, call the LSI Logic Sales Office/Design Center nearest you.

And do it ASAP. As if your future depended on it.

LSI LOGIC CORPORATION

Milpitas, CA 408/263-9494, San Jose, CA 408/248-5100, Irvine, CA 714/261-0124, Sherman Oaks, CA 818/906-0333, Denver, CO 303/756-8800, Westport, CT 203/222-9336, Altamonte Springs, FL 305/339-2242, Boca Raton, FL 305/395-6200, Schaumburg, IL 312/397-0155, Waltham, MA 617/890-0180 (Design Ctr), 617/890-0161 (Sales Ofc), Ann Arbor, MI 313/769-0175, Minneapolis, MN 612/835-6161, Trevose, PA 215/638-3010, Austin, TX 512/343-4513, Dallas, TX 214/788-2966, Bellevue, WA 206/455-5055. Nepean, Ontario, Canada 613/726-1585, England 44-344-426544, Tokyo, Japan 81-3-589-2711, West Germany 49-89-926903-0 LDS is a trademark of LSI Logic Corporation

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CIRCLE NO 84

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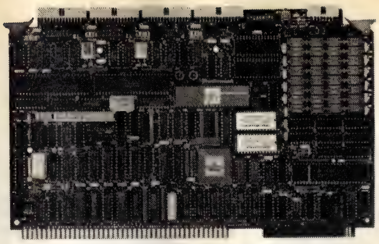
Board Level Products

Here's how our 8 plus years of experience saves you time and money: time because we have already designed and built these state-of-the-art boards for your high performance needs; money because we spread design/debug/testing costs over thousands of units. Call Peter Czuchra, Marketing Manager, to discuss how our high quality, high reliability boards will save you time and money on your next application.

OMNIBYTE CORPORATION
245 W. Roosevelt Rd.
West Chicago, IL 60185-3790
(312) 231-6880
Intl. Telex: 210070 MAGEX UR

A Look at Today . . . A Vision of Tomorrow

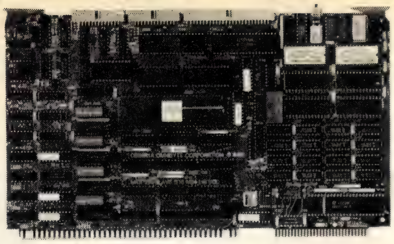


0B68K/MSBC1™ MULTIBUS* SINGLE BOARD COMPUTER

- 12.5MHz 68000 16/32 bit CPU (other speeds and 68010 optional)
- 256K/512K/1M/2M bytes dual-ported; zero-wait-state RAM with parity
- (4) RS-232C serial Synchronous/Asynchronous multiprotocol I/O ports
- (1) iSBX* expansion connector
- (4) 28 pin ROM sockets (up to 256KB)
- Optional memory management
- Omnibyte two year limited warranty

*Multibus and iSBX are trademarks of Intel Corp.

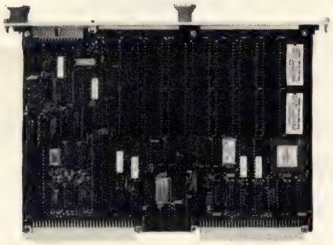
CIRCLE 1



0B68K1A™ MULTIBUS SINGLE BOARD COMPUTER

- 10MHz 68000 16/32 CPU
- 32K/128K/512K bytes zero-wait-state dual-ported RAM
- Up to 192K bytes of EPROM
- (2) RS-232C serial ports
- (2) 16-bit parallel ports
- A triple 16-bit timer/counter
- (7) prioritized-vectored interrupts
- Omnibyte two year limited warranty

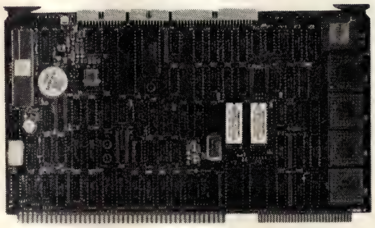
CIRCLE 2



0B68K/VME1™ SINGLE BOARD COMPUTER ON THE VME BUS

- 12.5MHz 68000 16/32 bit CPU
- (8) pairs of 28-pin sockets for RAM and ROM (up to 448K RAM or 896K ROM)
- (2) RS-232C serial ports using (1) 68681 DUART
- (2) 8-bit parallel I/O ports using (1) 68230 PI/T
- System controller functions are supported
- (7) Prioritized bus or auto vectored prioritized interrupts
- Omnibyte two year limited warranty

CIRCLE 3

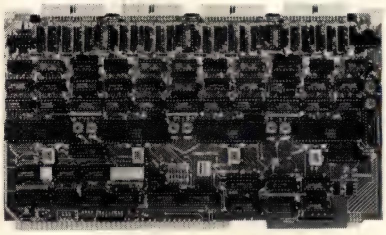


0B68K/MMU™ MULTIBUS CPU BOARD WITH OPTIONAL MEMORY MANAGEMENT

- 10MHz 68010 16/32 bit CPU
- Up to (4) 68451 Memory Management Units (optional)
- High speed iLBX* memory port
- 8 channel DMA port
- (2) RS-232C serial ports
- 4K/16K bytes of RAM
- (2) 28-pin ROM sockets
- Omnibyte two year limited warranty

*iLBX is a trademark of Intel Corp.

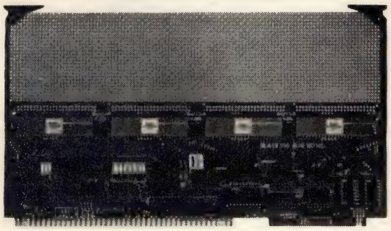
CIRCLE 4



0B68K/OCTAL™ MULTIBUS SERIAL I/O BOARD

- (8) RS-232C or RS-422 serial I/O ports
- Individually programmable baud rates between 50 and 38.4K baud
- (4) 68681 DUART chips
- (4) Multi-function programmable 16-bit counter/timers
- Omnibyte two year limited warranty

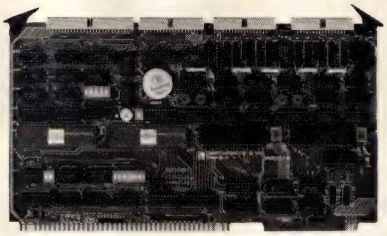
CIRCLE 5



0B68K230™ MULTIBUS 96-BIT PARALLEL I/O TIMER BOARD

- 96 bits of software definable parallel I/O
- (4) 68230 PI/T chips
- (4) 24 bit timers
- 35 sq. in. of prototyping area
- Omnibyte two year limited warranty

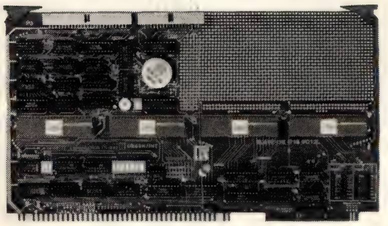
CIRCLE 6



0B68K/INT(S)™ MULTIBUS HOST ADAPTER/SERIAL I/O BOARD

- (2) 68230 PI/T chips
- (2) 68681 DUART chips
- (4) RS-232C or RS-422 serial I/O ports
- SASI interface to disk controller
- Parallel printer port
- Real time calendar clock with battery back-up
- Omnibyte two year limited warranty

CIRCLE 7



0B68K/INT(P)™ MULTIBUS HOST ADAPTER/PARALLEL I/O BOARD

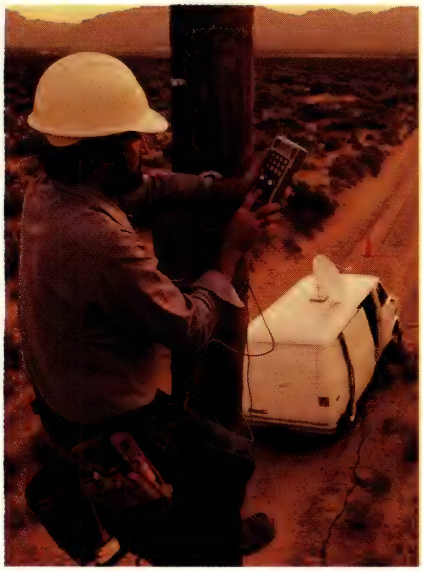
- 48 bits of software definable parallel I/O
- Real time calendar clock w/battery back-up
- (4) 68230 PI/T chips
- 15 sq. in. of prototyping area
- Parallel printer port
- SASI* interface to disk controller
- Omnibyte two year limited warranty

*SASI is a trademark of Shugart Associates.

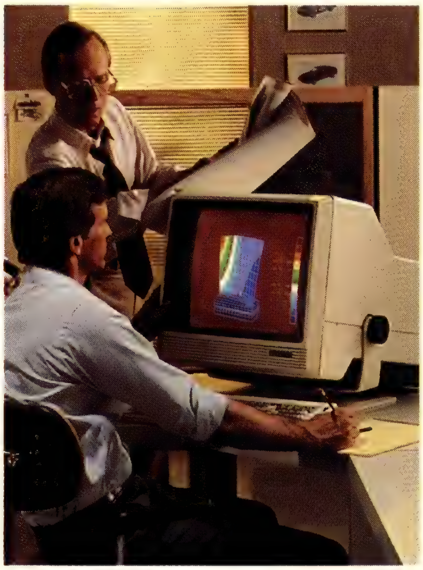
CIRCLE 8

New superfast signal processor
from Texas Instruments
keeps transactions strictly private...

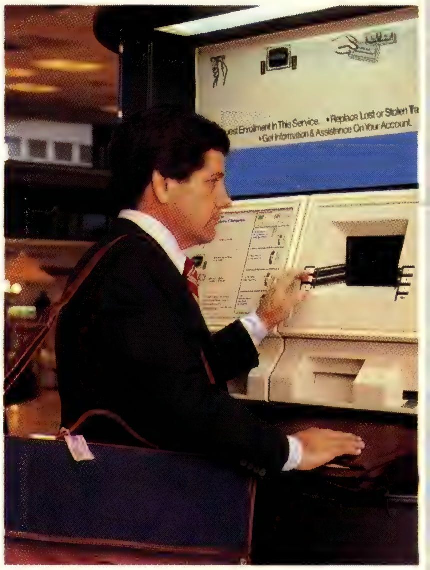
strengthens signals, enhances squelches echoes, and gets you Meet TI's new TMS32020



Echo cancellation can be greatly improved by using new TMS32020 processor, allowing telephone messages to come through loud and clear from anywhere.



Graphics systems could be economically implemented with TI's TMS32020 supplying throughput capability required for realtime rotation, scaling, and translation.



Enrollment In This Service • Replace Lost or Stolen
• Get Information & Assistance On Your Account

High-speed modems (4.8K bps to 19.2K bps) can be built with fewer chips and in shorter development time using TI's new TMS32020 processor.

It can handle all your digital signal processing (DSP) better than ever before. And as you will read, TI's new, single-chip TMS32020 can also be an efficient, economical processor for many high-speed, numeric-intensive applications.

And because it is available now, fully supported, the TMS32020 can speed your system development.

Up to three times faster throughput

TI's new TMS32020 processor delivers two to three times the throughput of the industry standard, TI's own TMS32010.

Behind this dramatic increase are (1) an expanded instruction set with repeat feature, (2) an expanded memory capability both on chip and off, and (3) much faster I/O.

Like the TMS32010, the TMS32020 utilizes a modified Harvard architecture emphasizing overall system throughput, communication, and flexibility in processor configuration.

Increased capability and flexibility

Having greater throughput, TI's TMS32020 makes fast work of filtering, correlation, windowing, transforms, wave-form generation, and all your other DSP tasks. 544 words of on-chip RAM, 32-bit arithmetic, single-cycle multiply/accumulate instructions, and an independent auxiliary register arithmetic unit further equip the TMS32020 for realtime DSP systems.

However, the capabilities of the TMS32020 should challenge your imagination. Its 64K word program *and* 64K data-memory spaces, timer, serial port, multiple-interrupt structure, provision for external wait states, and multiprocessor interface capability make the TMS32020 a natural choice for wide use.

And the TMS32020 is economical. Through VLSI implementation, the TMS32020 incorporates all these features into a single, 68-pin grid-array package.

Full support shortens development time

A wide range of development hardware and software tools is available to shorten your design cycle. Included are full-speed emulators, software simulators and assemblers/linkers, and application reports, plus other documentation (*see box*).

Three-day DSP workshops are conducted periodically at TI's Regional Technology Centers, and TI application engineers are also ready to provide help. Extensive third-party support is available.

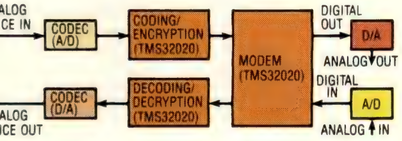
A TMS32020 applications handbook and additional documentation are only 11 quick keystrokes away, 1-800-232-3200, ext. 3502, or use the coupon on page 4.

Where economy is a prime design consideration and system requirements are less demanding, use TI's industry-standard TMS32010 DSP. An extended temperature range military version is also available.

Top secrets stay top secret when secure-telephony systems (on cover) are designed using TI's new TMS32020 signal processor. Its vastly improved throughput allows it to perform all critical subroutines so rapidly that deciphering the code is made virtually impossible.

graphics,
o market faster.
digital signal processor chip.

MS32020 provides all ecure-telephony features



ecause it can perform several func- ons by simply executing a variety subroutines, TI's TMS32020 rocessor is a prime candidate for cure-telephony applications.

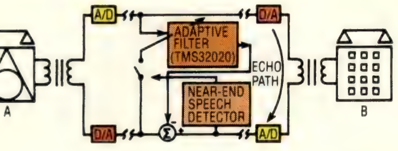
For example, multiple MS32020s can compress the voice, ncrypt the digital signals, and act a modem.

The fast cycle time of the MS32020 is not only essential to e encryption/decryption routine ut can also allow the routine to be onstantly varied so that cracking e code would be difficult.

The large program memory, serial ort, and single-cycle multiply/ ccumulate facilitate the coding, ecoding, and modem routines.

Thus, the TMS32020 is an fective alternative to the costly lly custom circuits you would ave to use to gain equivalent pro- essing power.

MS32020 cancels echoes ore accurately

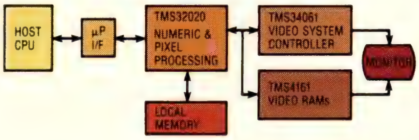


or more effective echo cancella- on, the 544-word on-chip data emory of TI's TMS32020 enables to provide larger, more accurate aptive filters. Because of this emory and the single-cycle ultiply/accumulate/data move, the MS32020 can execute and update 128-tap adaptive filter needed by e echo-cancellation-model rou- ne. And the extraordinary speed of e TMS32020 allows the adaption utine to execute in real time.

The TMS32020 completes a multiply/accumulate/data move in a single cycle. Its "repeat instruction" allows the next instruction to be repeated "N" times, which saves program memory space and effectively pipelines the instruction.

In addition, the 544 words of on-chip data RAM allow quick updates of taps for faster adaptation, and the serial I/O port allows direct interface to a codec with little or no "glue" logic.

TMS32020 excels at fast matrix manipulations


HOST CPU
μP I/F
TMS32020 NUMERIC & PIXEL PROCESSING
TMS34061 VIDEO SYSTEM CONTROLLER
MONITOR
TMS4161 VIDEO RAMs
LOCAL MEMORY

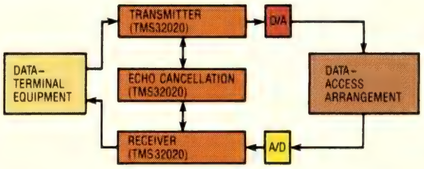
In graphics applications, TI's TMS32020 processor can be used for both numeric and pixel processing. Its 200-ns multiply/accumulate allows the TMS32020 to execute realtime graphics scaling, rotation, and translation. All depend upon memory-intensive matrix manipulations that require rapid execution.

The block-move feature of TI's TMS32020 — up to 80 Mbits per second — allows the large data blocks involved to be accessed in real time to manipulate the screen. The TMS32020 is capable of addressing up to 64K 16-bit words of data used to store the pixel information. Among other features that give the TMS32020 an edge in graphics systems are the scaling shifter used in pixel or bit alignment and the wait states that allow communication with slower DRAMs/VRAMs.

Because a graphics system must interface to a host processor, the host-interface logic on the TMS32020 eases your design task.

TMS32020 simplifies high-speed modem design

Using multiple TMS32020 processors in high-speed modems is a logical choice over costly fully custom chips. The TMS32020 combines easy programming with large data memory, multiprocessor and serial interfaces, overflow mode, large program memory, and table access of program memory.



Since many high-speed modems require more than one programmable DSP chip, the built-in multiprocessing interface of the TMS32020 minimizes component count and simplifies design.

Adaptive FIR filters require the single-cycle multiply/accumulate/ data move and the large data memory of the TMS32020 for high-speed computations and realtime implementation.

The overflow-saturation mode minimizes errors caused by an overflowing accumulator and produces a "clean filter."

Program memory of up to 64K words permits multiple bit rates and standards to be supported simply in software rather than hardware.

For more applications data, call 1-800-232-3200, ext. 3502, or check the coupon on page 4.

Samples of TI's new 32020 are available now through authorized TI distributors, at $250.* Volume production is slated for early 1986. Development-support tools are also available off the shelf.

TMS32020 Software and Hardware Support

Host Computer	Operating System	Part Number
Macro Assembler/Linkers		
DEC VAX	VMS	TMDS3241210-08
TI/IBM PC	MS-DOS	TMDS3241810-02
Simulators		
DEC VAX	VMS	TMDS3241211-08
TI/IBM PC	MS-DOS	TMDS3241811-02
Hardware		
Emulator		TMDS3262220

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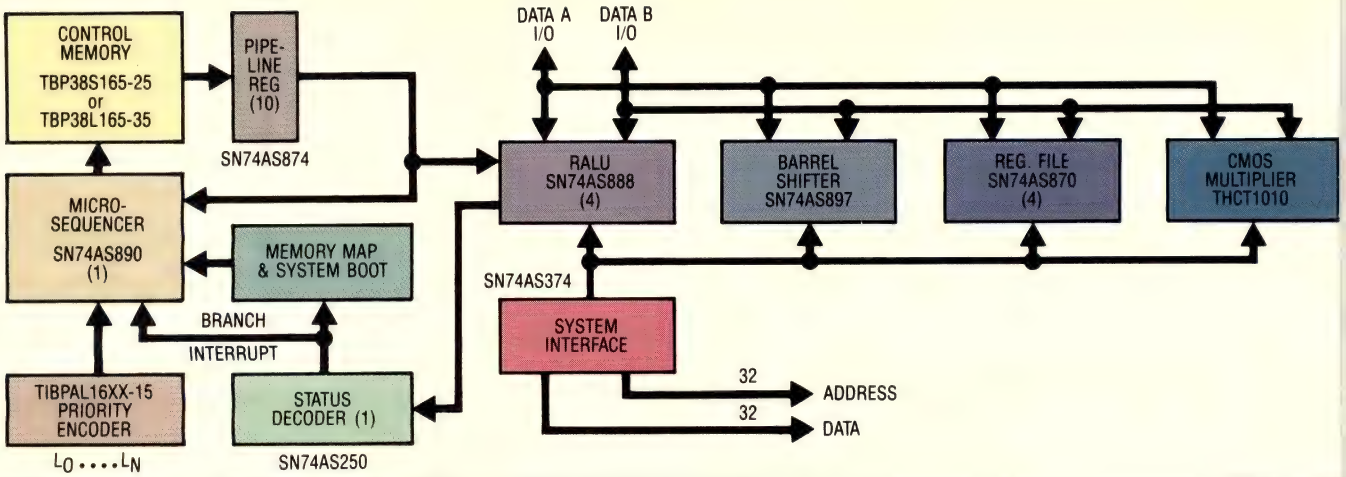
*Suggested retail, quantity 1, U.S.A.

Turn the page for more information.



High system performance and low-power operation result when four of TI's new 74AS888 8-bit-slice processors are cascaded to form a 32-bit CPU with TI's new, low-power THCT1010 speeding multiplier/accumulator operations.

TI redefines your idea of speed/power ratios with its new bit-slice/multiplier team.

For many applications requiring exceptional system execution speeds, TI's new 74AS888 8-bit-slice processor can prove the effective alternative to the TMS32020 DSP.

Usually, when you increase system performance significantly, power consumption follows right behind — just as night follows day.

Not so with TI's IMPACT™ 74AS888 and new THCT1010 multiplier/accumulator. This team sends power and performance on their separate ways. One up . . . the other down.

The innovative 74AS888 has an instruction-to-Y output of 46 ns maximum, or a 51% improvement over the 4-bit competition. Power dissipation is only 1.5 W maximum during operation.

Multiplies and divides are about as fast as additions. Flexible microinstructions let you tailor an application-precise instruction set. You can use any software. Any word length in 8-bit increments. Emulate any known µP instruction set while achieving improvements in execution speeds.

The 74AS888 is fully supported and readily available through TI distributors so you can get your system design finalized in minimum time.

TI's new THCT1010 is pin-for-pin compatible with the industry-standard multiplier (TDC1010J) but consumes 30 times less power. In conjunction with the 74AS888, it can significantly cut the power requirements of bit-slice systems.

Fabricated in silicon-gate CMOS, the THCT1010 is a 16- × 16-bit multiplier with 35-bit accumulator. How fast is it? For the -100 suffix, 100 ns maximum with a worst-case power consumption of only 150 mW.

If you want more details on the 74AS888 and THCT1010, just dial the 800 number below or clip and mail the coupon.

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27-5287

Texas Instruments Incorporated
P.O. Box 809066
Dallas, Texas 75380-9066

Expires June 30, 1986
SPR103ED500C

YES, please send me the information checked below.

PR22 ☐ TMS32020 Applications Handbook
PR25 ☐ TMS32020 User's Guide
PR12 ☐ TMS32020 Third-party Support
PR30 ☐ Digital Signal Processing Newsletter
DB01 ☐ IMPACT 74AS888 8-bit-slice Processor Data Sheet and User's Guide
CL04 ☐ THCT1010 CMOS Multiplier/Accumulator Data Sheet

NAME
TITLE
COMPANY
ADDRESS MAIL STATION
CITY STATE ZIP
AREA CODE TELEPHONE EXT.

For quick response to your information needs, call Texas Instruments today at **1-800-232-3200.**

TEXAS INSTRUMENTS
Creating useful products and services for you.

SUPPORT FACILITIES
None.

CYCLE TIMES
DESIGN: 1 to 3 weeks.
PROTOTYPING: 4 to 6 weeks.

INPUTS FOR COST ESTIMATION
Schematic or function diagram.

PRODUCTION COMMITMENTS
None.

ALTERNATE SOURCES
None.

Integrated Logic Systems Inc
4445 Northpark Dr,
Suite 102
Colorado Springs, CA 80907
(303) 590-1588
Circle No 552

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated net list or schematic.

DESIGN TOOLS
Design tools include schematic capture, net-list generation, logic simulation, layout, design-rule check, automatic test-vector generation using scan design, and automatic test-program generation.

WORKSTATION SUPPORT
Mentor, Daisy, and Futurenet.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning, schematic capture, functional simulation.
CUSTOMER PERFORMS ON VENDOR'S TOOLS: Simulation.
VENDOR PERFORMS: Turnkey design or layout and post-routing simulation.

SUPPORT FACILITIES
Colorado Springs, CO.

CYCLE TIMES
DESIGN: 2 to 3 weeks.
PROTOTYPING: 5 to 6 weeks.

INPUTS FOR COST ESTIMATION
Schematic preferred, gate count acceptable.

PRODUCTION COMMITMENTS
None.

Integrated Microcircuits Inc
1515 S 6th St
Hopkins, MN 55343
(612) 933-4600
Circle No 553

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic, layout data generated by vendor's software.
DISCOURAGED: Unsimulated schematic, layout data generated by customer's software.

DESIGN TOOLS
Tools run on Calma GDS-1 CAD systems and provide simulation and interactive layout.

WORKSTATION SUPPORT
Layout information for Calma and Via Systems.

DESIGN CYCLE
VENDOR PERFORMS: All design steps.

TRAINING
COURSE: None.
DOCUMENTATION: Design manuals available prior to design commitment; $50.

SUPPORT FACILITIES
Hopkins, MN.

CYCLE TIMES
DESIGN: 3 to 6 weeks.
PROTOTYPING: 5 to 8 weeks.

PRODUCTION COMMITMENTS
None.

International Microcircuits Inc
3350 Scott Blvd
Santa Clara, CA
(408) 727-2280
Circle No 554

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic.
ACCEPTABLE: Functional block diagram, unsimulated schematic or net list, layout data, PG tapes.

DESIGN TOOLS
IMI's CAE system runs on VAX minicomputers.

WORKSTATION SUPPORT
Mentor, Daisy, and Valid.

DESIGN CYCLE
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Partitioning analysis, functional simulation, logic design and simulation, timing analysis, test-program generation, testability analysis, fault grading.
VENDOR PERFORMS: Layout and post-layout analysis.

FUNCTION LIBRARY
Library includes 110 functions; users can create library elements based on existing functions or discrete gates; all library cells have been built and tested; simulation parameters include ID, LD, SUH, TS, VS, PD, FI, and FO.

TRAINING
COURSE: A 5-day training course is available in Santa Clara, CA prior to design commitment; $2000.
DOCUMENTATION: Design manuals are available prior to design commitment; updated yearly; free with $2000 Daisy macrocell library.

SUPPORT FACILITIES
Santa Clara, CA.

CYCLE TIMES
DESIGN: 4 to 20 weeks.
PROTOTYPING: 3 to 4 weeks.

INPUTS FOR COST ESTIMATION
Logic drawings.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
Multiple wafer sources.

ITT VLSI Design Center
15 Progress Dr
Shelton, CT 06484
(203) 929-9790
Circle No 555

CUSTOMER/VENDOR INTERFACE
PREFERRED: Verified net list in Mentor or Valid workstation format.
DISCOURAGED: Net list in other formats.

DESIGN TOOLS
Tools provide schematic capture, logic simulations, automatic and manual layout, layout-parameter extraction, back-annotation simulation, translation of simulation test vectors to Sentry functional-test program.

WORKSTATION SUPPORT
Mentor and Valid.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Logic design, test-vector generation, design specification.
CUSTOMER PERFORMS ON VENDOR'S TOOLS: Schematic capture, initial and back-annotated simulation.
VENDOR PERFORMS: Layout, layout-parameter extraction, design-rule checks, network-equivalency check, test-vector translation.

TRAINING
COURSE: Available.
DOCUMENTATION: Design files for workstations and datasheets available.

CYCLE TIMES
DESIGN: 8 weeks for 3000-gate array.
PROTOTYPING: 13 weeks from verified net list.

INPUTS FOR COST ESTIMATION
Schematics or circuit description, volume, schedule.

PRODUCTION COMMITMENTS
None.

Kontron Electronics
630 Price Ave
Redwood City, CA 94063
(415) 361-1012
Circle No 556

CUSTOMER/VENDOR INTERFACE
PREFERRED: Physical layout data generated by vendor's software.
ACCEPTABLE: Functional block diagram, simulated or unsimulated schematic or net list, layout data generated by customer's software, PG tapes.

DESIGN TOOLS
Kontron offers Micad, a stand-alone gate-array design system. The workstation supports design entry, logic simulation, and automatic and interactive layout functions.

DESIGN CYCLE
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Logic design and simulation, timing analysis, critical-path analysis, interactive and automatic placement, automatic routing, network-equivalency check, post-routing simulation.
VENDOR PERFORMS: Test-program generation, testability analysis, fault grading, custom cell creation.

FUNCTION LIBRARY
Library contains 160 functions built from as many as 85 2-input gates; users must use only predefined library elements; 50% of library cells have been fabricated and tested; simulation parameters include ID, LD, SUH, VS, TS, FI, and FO.

TRAINING
COURSE: Training is available before design commitment.
DOCUMENTATION: Design manuals are available without design commitment; $25.

CYCLE TIMES
DESIGN: 1 to 2 weeks.
PROTOTYPING: 2 to 4 weeks.

INPUTS FOR COST ESTIMATION
Approximate gate count, performance specifications, production volumes, delivery schedules.

PRODUCTION COMMITMENTS
None.

ALTERNATE SOURCES
AMI-Austria (AMI-USA acts as an alternate source for wafers).

Linear Technology Inc
Box 489, Station A
Burlington, Ontario, Canada L7R 3Y3
(416) 632-2996
Circle No 557

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list, layout data generated by vendor's software.
ACCEPTABLE: Functional block diagram, unsimulated schematic or net list, layout generated by customer's software.

DESIGN TOOLS
LTI offers a design kit including manuals and large layout sheets. Internal layout data available for Computervision, Calma, and Applicon CAD systems under nondisclosure agreement.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, functional simulation, critical-path analysis, test-pattern generation, manual routing.
VENDOR PERFORMS: Testability analysis, fault grading, placement and routing, custom cell creation, circuit breadboarding, post-routing simulation, network-equivalence check.

TRAINING
COURSE: A 1-day seminar and a 5-day training course are available in Burlington, Ontario.
DOCUMENTATION: Design manuals available on magnetic tapes; $20.

SUPPORT FACILITIES
Burlington, Ontario, Canada; Sherbrooke, Quebec, Canada; and Tokyo, Japan.

CYCLE TIMES
DESIGN: 2 to 4 weeks.
PROTOTYPING: 8 to 12 weeks.

INPUTS FOR COST ESTIMATION
Detailed design data.

PRODUCTION COMMITMENTS
None required.

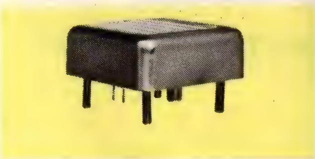
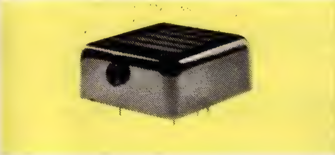
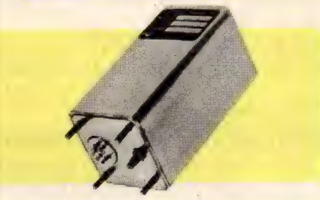
ALTERNATE SOURCES
None.

Your One-Stop Source for...

VECTRON

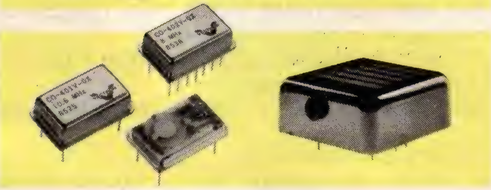
Crystal Oscillators

LOW PHASE NOISE MODELS

	Non-Compensated (XOs)	Temperature Compensated (TCXOs)	Oven Controlled (OCXOs)
			
Frequency:	5 MHz - 1 GHz	1 MHz - 630 MHz	1 MHz - 400 MHz
Output:	+7dBm into 50Ω; TTL, CMOS, ECL and higher level sine optional		
Temp. Stability Options:	±25 ppm over 0/+70°C ± 3 ppm over 0/+50°C ±50 ppm over −55/+85°C	±2x10^{-7} over 0/+50°C ±5x10^{-7} over −20/+70°C ±1x10^{-6} over −55/+85°C	±1x10^{-8} over 0/+50°C ±3x10^{-8} over −20/+70°C ±5x10^{-8} over −55/+75°C
Aging:	5 ppm/year (2 ppm/year optional)	1 - 2x10^{-6}/year (depending upon frequency)	1x10^{-8}/day (as low as 1x10^{-10}/day available)

Phase Noise (@ 50 MHz)	XOs 1 KHz	XOs 50 KHz	TCXOs 1 KHz	TCXOs 50 KHz	OCXOs 1 KHz	OCXOs 50 KHz
Standard:	−125dBc/Hz	−150dBc/Hz	−130dBc/Hz	−145dBc/Hz	−140dBc/Hz	−150dBc/Hz
L2 Option:	−140dBc/Hz	−160dBc/Hz	−140dBc/Hz	−160dBc/Hz	−150dBc/Hz	−160dBc/Hz

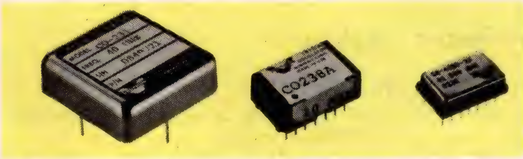
Voltage Controlled Models



	PLL VCXOs	LINEAR VCXOs	VCOs (non-crystal)
Deviation:	±.003% to ±.02%	±.01% to ±1%	±1% to ±33%
Frequency:	to 600 MHz	to 400 MHz	to 500 MHz
Linearity:	±10% to ±20%	±1% to ±5%	±1% to ±10%
Stability: (0-50°C)	±.001% (wider temp. ranges, to −55/+85°C, optional)	*±.001% to ±.01%	±.3% to ±1%

*Higher stability temperature compensated and oven controlled VCXOs also available.

Clock Oscillators (TTL, CMOS, ECL)



	PCB MOUNT	COMMERCIAL DIP (epoxy sealed)	LOW PROFILE DIP (resistance welded)
TTL	1 Hz-100 MHz	16 KHz-100 MHz	16 KHz-100 MHz (QPL'd to MIL-O-55310/16)
CMOS	.01 Hz-15 MHz	N/A	1 Hz-50 MHz (QPL'd to MIL-O-55310/18)
ECL	5 MHz-500 MHz	5 MHz-200 MHz	5 MHz-150 MHz
Accuracy (at 25°C):	±10 ppm, ±15 ppm, ±25 ppm or ±50 ppm (most models also available settable to ±1 ppm via either internal or external variable capacitor).		
Stability:	Standard: ±25 ppm over 0°C to + 70°C Option 2: ±50 ppm over −55°C to + 125°C Option 5: ± 5 ppm over 0°C to + 50°C		

VECTRON

The Crystal Oscillator Company

Vectron Laboratories, Inc.

166 Glover Avenue, Norwalk, Connecticut 06850
Telephone: 203/853-4433 TWX: 710/468-3796

EDN SEMICUSTOM-IC DIRECTORY

LSI Logic Corp
1551 McCarthy Blvd
Milpitas, CA 95035
(408) 263-9494
Circle No 558

CUSTOMER/VENDOR INTERFACE

PREFERRED: Simulated net list and test vectors generated using company's design software.

DESIGN TOOLS

LDS design system provides schematic capture, net-list entry, worst-case delay prediction, simulation, and test-tape generation.

WORKSTATION SUPPORT

Daisy, Mentor, Valid, Sun, Futurenet, and P-Cad systems.

DESIGN CYCLE

CUSTOMER PERFORMS USING OWN TOOLS: Logic design, simulation, and test-program generation.

CUSTOMER PERFORMS USING VENDOR'S TOOLS: Testability analysis, post-layout simulation.

VENDOR PERFORMS: Layout.

FUNCTION LIBRARIES

Libraries contain 273 functions built from as many as 744 2-input gates; users can define new functions using existing library elements; all elements have been fabricated and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

TRAINING

COURSE: One-week course offered at design centers.

DOCUMENTATION: Design manuals available to course attendees.

SUPPORT FACILITIES

Milpitas, CA; Irvine, CA; Sherman Oaks, CA; Minneapolis, MN; Waltham, MA; Dallas, TX; Boca Raton, FL; London, UK; Munich, West Germany; Düsseldorf, West Germany; Bracknell, UK; Tel Aviv, Israel; Tokyo, Japan; Osaka, Japan; and 20 distributor design centers in US and Europe.

CYCLE TIMES

DESIGN: 1 to 8 weeks.

PROTOTYPING: 4 to 8 weeks.

INPUTS FOR COST ESTIMATION

Gate count, pin count, critical-path delay or system clock frequency, temperature range, memory requirements.

PRODUCTION COMMITMENTS

None required.

ALTERNATE SOURCES

AMD, Toshiba, RCA, SGS, Raytheon.

Marconi Electronic Devices
Doddington Rd
Lincoln, UK
(0522) 688121
Circle No 559

CUSTOMER/VENDOR INTERFACE

PREFERRED: Simulated net list in Hilo format, layout.

DISCOURAGED: PG tape.

DESIGN TOOLS

Design tools include the Hilo logic simulator and proprietary layout software.

WORKSTATION SUPPORT

Mentro, Daisy, Valid.

DESIGN CYCLE

CUSTOMER PERFORMS USING OWN TOOLS: Schematic capture, simulation.

CUSTOMER PERFORMS USING VENDOR'S TOOLS: Layout.

VENDOR PERFORMS: All steps at customer's discretion.

TRAINING

COURSE: Interactive array-design courses offered at customer's site or London design center.

DOCUMENTATION: Controlled manuals available.

CYCLE TIMES

PROTOTYPING: 8 to 12 weeks, depending on vendor's involvement in design steps.

PRODUCTION COMMITMENTS

None.

Matra Design Systems
120B Albright Way
Los Gatos, CA 95030
Circle No 560

CUSTOMER/VENDOR INTERFACE

PREFERRED: Simulated or unsimulated schematic or net list, layout data generated by vendor's software.

ACCEPTABLE: Functional block diagram, PG tapes.

DISCOURAGED: Layout data generated by customer's software.

DESIGN TOOLS

All software—including logic simulation, placement, and routing—runs on IBM PC/AT or PC/XT in addition to a VAX 750 or 780. Layout software includes internal layout data subject to a nondisclosure agreement.

DESIGN CYCLE

CUSTOMER PERFORMS USING OWN TOOLS: Logic design and minimization, critical-path analysis.

CUSTOMER PERFORMS USING VENDOR'S TOOLS: All design steps except custom-cell creation.

VENDOR PERFORMS: Any steps at customer's discretion.

FUNCTION LIBRARIES

Library includes 120 cells built from as many as 76 2-input gates; users can define new functions based on existing library elements; all functions have been fabricated and tested; simulation parameters include ID, LD, VS, TS, FI, and FO.

TRAINING

COURSE: A 2- to 5-day training course in Santa Clara, CA is available prior to design commitment.

DOCUMENTATION: Design manuals are available prior to design commitment; manuals are updated quarterly.

SUPPORT FACILITIES

Santa Clara, CA; France; Germany; and UK.

CYCLE TIMES

DESIGN: 1 to 2 weeks.

PROTOTYPING: 2 to 3 weeks.

INPUTS FOR COST ESTIMATION

Array size, production volume, extent of design support by vendor.

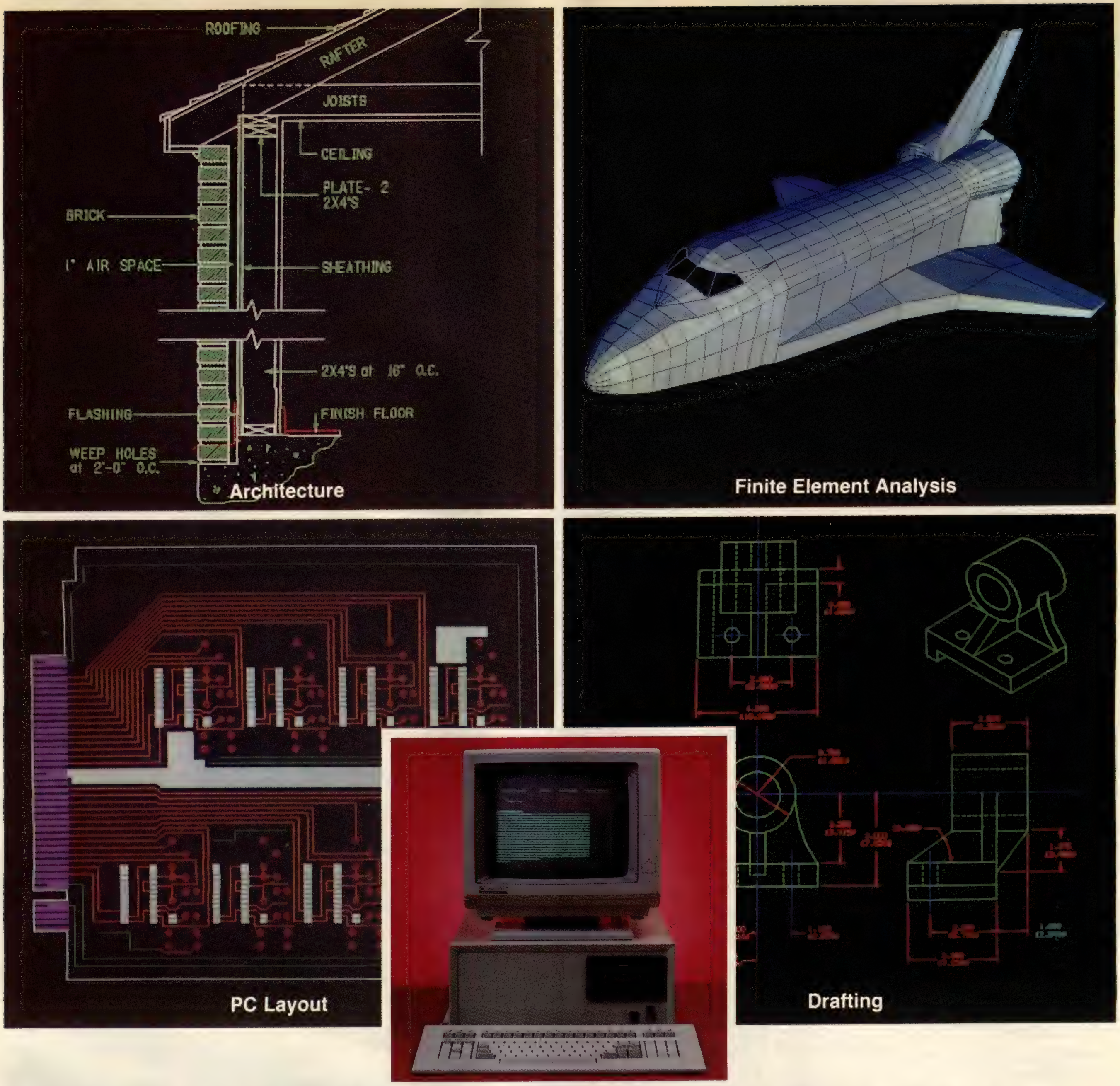
PRODUCTION COMMITMENTS

None required.

ALTERNATE SOURCES

Harris Semiconductor.

Continued on pg 167



Architecture

Finite Element Analysis

PC Layout

Drafting

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For more information, contact:
Graphics Marketing, Lundy Electronics & Systems, Inc., One Robert Lane, Glen Head, N.Y. 11545.
(516) 671-9000.

LUNDY®

CIRCLE NO 86

EQN(1) UNIX Programmer's

NAME
eqn, neqn, checkeq - typeset mathemati

SYNOPSIS
eqn [-dxy] [-pn] [-sn] [-fn] [file] ...
checkeq [file] ...

DESCRIPTION
Eqn is a troff(1) preprocessor for typese
tems phototypesetter, *neqn* on terminals.

eqn file ... | troff
neqn file ... | nroff

If no files are specified, these programs
beginning with '.EQ' marks the
marked by a line beginning
may be defined in macro pa
possible to set two characte
iters is also treated as *eqn*
with the command-line argu
between .EQ and *.EN*. The left
are turned off by 'delim off'
between .EQ and .EN is passed

The program *checkeq* reports
pairs.

Tokens within *eqn* are separa
quotes, tildes or circumflexes.
ing, anywhere a single characte
tion enclosed in braces may be u
the output, circumflex ^ half as m

Subscripts and superscripts are
x sub i makes x_i, *a sub i sup 2* pro
$e^{x^2+y^2}$.

Fractions are made with **over**: *a ove*

sqrt makes square roots: *1 over sqrt*

The keywords **from** and **to** introduce
$\lim_{n \to \infty} \sum_0^n x_i$ is made with *lim from {n- > in*

Left and right brackets, braces, etc.,

right: *left [x sup 2 + y sup 2 over al*

The **right** clause is optional. Legal cha
brackets, bars, **c** and **f** for ceiling and flo
right-side-only bracket).

Vertical piles of things are made with **pile**,
produces $\begin{matrix}a\\b\end{matrix}$. There can be an arb

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CIRCLE NO 87

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Resistors:	531	869
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CAD	YES	YES

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CIRCLE NO 88

MCE Semiconductor Inc
1111 Fairfield Dr
West Palm Beach, FL 33407
(305) 845-2837
Circle No 561

CUSTOMER/VENDOR INTERFACE
PREFERRED: Functional block diagram, unsimulated schematic or net list, layout data generated using vendor's tools; PG tapes.
ACCEPTABLE: Simulated schematic or net list, layout data generated using customer's software.

DESIGN TOOLS
MCE offers a series of breadboarding tools that aid in circuit design and verification. The firm also offers Aspec and Spice simulators for circuit analysis and several proprietary layout and verification tools for post-routing checks.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Logic minimization and fault grading.
VENDOR PERFORMS: Logic design, simulation, timing analysis, critical-path analysis, testability analysis, all layout and layout-verification functions.

FUNCTION LIBRARIES
Users can define new functions based on existing cells or discrete components; all cells have been fabricated and tested; simulation parameters include ID, LD, VS, TS, PD, FI, and FO.

TRAINING
COURSE: A ½-day session is available before design commitment; 3-day session is offered after design commitment; courses offered in US and West Germany.
DOCUMENTATION: Design manuals available without design commitment; $5 to $100.

SUPPORT FACILITIES
West Palm Beach, FL; Sunnyvale, CA; Tewkesbury, UK; and in Nurenburg and Munich, West Germany.

CYCLE TIMES
DESIGN: 4 to 16 weeks.
PROTOTYPING: 2 to 4 weeks.

INPUTS FOR COST ESTIMATION
Chip data, utilization, test requirements.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
None.

Micro Linear
2092 Concourse Dr
San Jose, CA 95112
(408) 262-5200
Circle No 562

CUSTOMER/VENDOR INTERFACE
PREFERRED: Any level.

DESIGN TOOLS
Micro Linear offers an IBM PC/XT-based system for schematic capture, simulation, and timing analysis. Simulation and layout software runs on VAX mincomputers.

WORKSTATION SUPPORT
Daisy.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: All steps from partitioning through layout.
VENDOR PERFORMS: Design through tooling depending on customer involvement.

FUNCTION LIBRARIES
Library includes 30 elements; users can build new functions from existing library elements or discrete devices; 100% of all functions have been fabricated and tested.

TRAINING
DOCUMENTATION: Design manuals available after design commitment.

CYCLE TIMES
DESIGN: Depends on complexity.
PROTOTYPING: 4 to 10 weeks.

INPUTS FOR COST ESTIMATION
System specifications, block diagram or schematic, functional description, customer design involvement, volume, and schedule.

PRODUCTION COMMITMENTS
Negotiable for customer-designed arrays, required for vendor-designed arrays.

Mitel Semiconductor
350 Leggett Dr
Kanata, Ontario, Canada
(613) 592-5280
Circle No 563

CUSTOMER/VENDOR INTERFACE
PREFERRED: PG tape.

DESIGN TOOLS
Mitel's CAE system supports logic design, simulation, and manual layout tasks. The software runs on a VAX minicomputer and Calma and Computervision CAD systems. It accepts data in gate- or macro-level schematic diagrams. In addition, a layout kit allows chip design without CAE tools; users affix adhesive overlays to scaled layout sheets.

WORKSTATION SUPPORT
Daisy. Layout data available for Calma.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Logic design.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Simulation, manual layout.
VENDOR PERFORMS: Testability analysis, test-program generation.

FUNCTION LIBRARY
Library includes 100 functions built from as many as 18 2-input gates; users can build new functions from library elements; all functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, FI, and FO.

TRAINING
COURSE: Design courses are offered at customer's site or at Kanata, Ontario plant; price varies with depth of training.
DOCUMENTATION: Design manuals are available prior to design commitment; $100, updated yearly.

SUPPORT FACILITIES
PML Ltd (Vancouver, British Columbia, Canada) and the Circuit Design Group (Phoenix, AZ).

CYCLE TIMES
PROTOTYPING: 12 weeks.

INPUTS FOR COST ESTIMATION
Gate count, package style, pin count, production quantity, screening level.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
Plessey and GTE Microcircuits Div.

Mitsubishi Electronics America Inc
1050 E Arques Ave
Sunnyvale, CA 94086
(408) 730-5900
Circle No 564

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated logic diagram or net list.
DISCOURAGED: PG tape.

DESIGN TOOLS
Schematic capture, net-list generation, Tegas simulator, circuit simulation.

WORKSTATION SUPPORT
Daisy, Mentor, Valid, Futurenet.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Logic design, breadboard.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Schematic capture, simulation, timing verification.
VENDOR PERFORMS: Layout, post-layout simulation, tooling.

TRAINING
COURSE: Available.
DOCUMENTATION: Available.

SUPPORT FACILITIES
Sunnyvale, CA; Durham, NH.

CYCLE TIMES
DESIGN: 2 to 4 weeks.
PROTOTYPING: 4 to 6 weeks.

INPUTS FOR COST ESTIMATION
Gate density, package, customer/vendor interface, volume.

PRODUCTION COMMITMENTS
None.

Motorola Inc
2200 W Broadway Rd
Mesa, AZ 85036
(602) 962-2516
Circle No 565

CUSTOMER/VENDOR INTERFACE
ACCEPTABLE: Simulated or unsimulated schematics or net lists, PG tapes.

DESIGN TOOLS
Motorola offers workstation-based tools for schematic capture, logic simulation, and layout. Mainframe software performs other design steps.

WORKSTATION SUPPORT
Daisy, Mentor, P-Cad, Hewlett-Packard, Tektronix, Valid, Computervision, Futurenet.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN OR VENDOR'S TOOLS: Functional simulation, logic design and simulation, timing analysis, test-pattern generation, testability analysis, fault grading. Layout and post-layout analysis for bipolar arrays. CMOS arrays need vendor software for layout.
VENDOR PERFORMS: Custom cell creation.

FUNCTION LIBRARIES
ECL: Library includes over 120 functions built from as many as 22 2-input gates; users can build new functions from library elements; 99% of all functions have been built and tested; simulation parameters include ID, SUH, PD, FI, and FO.
TTL: Library includes over 80 functions built from as many as 22 2-input gates; users can build new functions from library elements; 99% of all functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.
CMOS: Library includes 65 functions built from as many as 18 2-input gates; users can build new functions from library elements; 100% of all functions have been built and tested; simulation parameters include ID, LD, SUH, FI, and FO.

TRAINING
COURSE: A 3- to 5-day course is available at Motorola Technology centers and customer sites prior to design commitment; $3000.
DOCUMENTATION: Documentation is available free prior to design commitment.

SUPPORT FACILITIES
Dallas, TX; Atlanta, GA; Maitland, FL; Livonia, MI; Boston, MA; River Edge, NJ; Chicago, IL; Minneapolis, MN; Denver, CO; San Jose, CA; Los Angeles, CA; Tokyo, Japan; Munich, West Germany; Tel Aviv, Israel; Hong Kong; Washington, DC; Vanves, France; Seoul, Korea; Singapore; Solna, Sweden; Taipei, Taiwan; Hauppauge, NY; Melbourne, Australia; Aylesbury, UK; and Toronto, CA.

CYCLE TIMES
PROTOTYPING: 7 to 10 weeks.

INPUTS FOR COST ESTIMATION
Array type, package type, production volume, schedule.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
National Semiconductor; NCR for CMOS arrays.

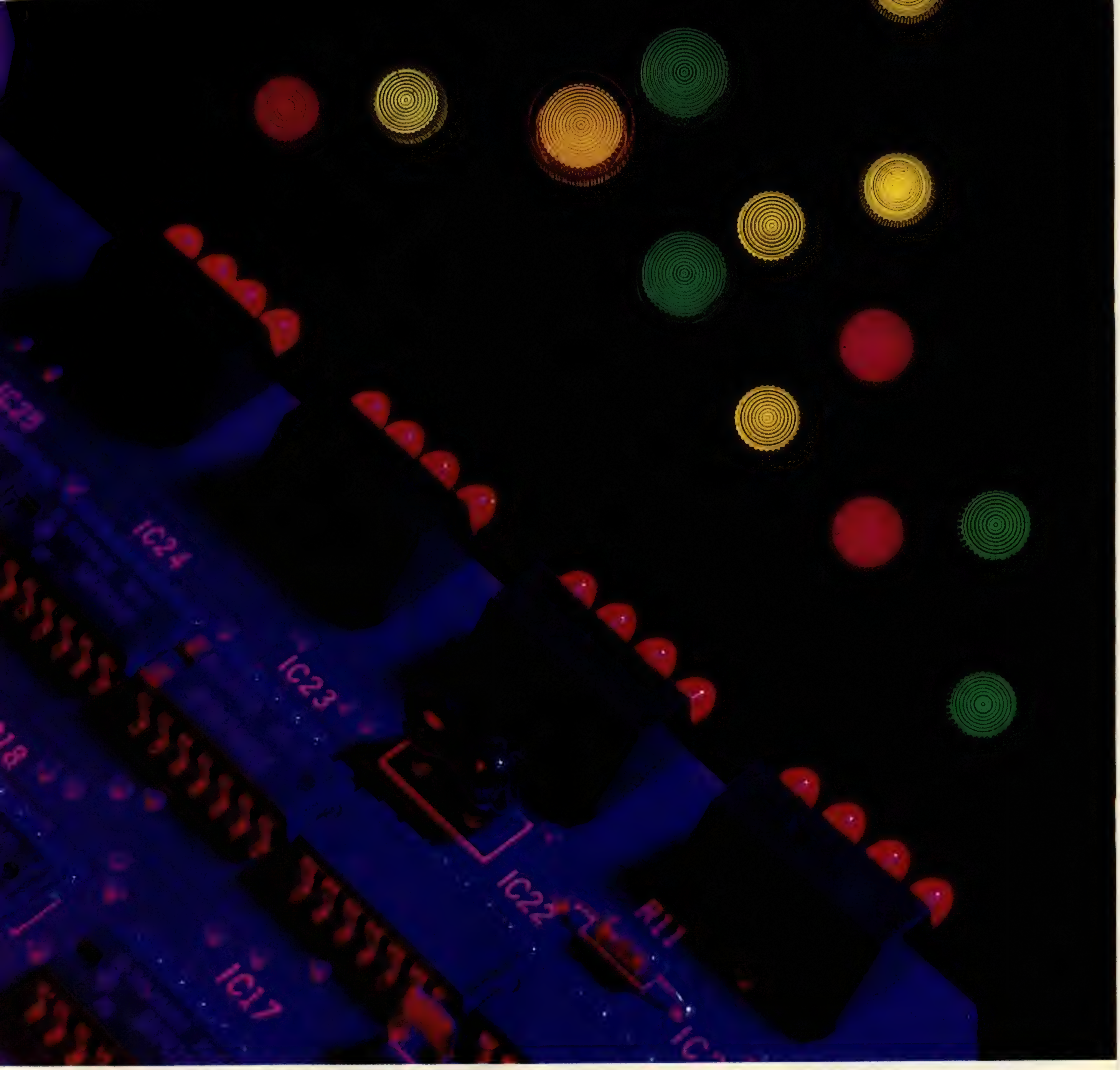
National Semiconductor Corp
2900 Semiconductor Dr
Santa Clara, CA 95051
(408) 721-5000
Circle No 566

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list, layout data generated by vendor's software.
ACCEPTABLE: Functional block diagram, unsimulated schematic or net list, layout data generated by customer's software, PG tapes.

WORKSTATION SUPPORT
Daisy, Mentor; layout data available for VR Systems and Mentor.

DESIGN CYCLE
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Logic design, simulation, timing analysis, logic minimization, critical-path analysis, testability analysis, fault grading, test-program generation, custom cell creation.
VENDOR PERFORMS: Array routing, network-equivalency check, post-routing simulation, partitioning analysis.

Continued on pg 173



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CIRCLE NO 90

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Feature Size:2μ

	N-Channel	P-Channel
VTEO	0.5–1.0$_V$	0.5–1.0$_V$
BVDSS	>10$_V$	>10$_V$
$K^1 = \frac{\mu c}{2}$ linear region	21–25	6.5—8.5
B_E(Long Channel)	0.8–1.2$_V^{1/2}$	0.4—0.6$_V^{1/2}$
Cap. Gate 10^4 PF/cm^2	8–10	8–10
Cap. Poly to Sub 10^4 PF/cm^2	0.55–0.65	0.55–0.65
Cap. Metal to Sub 10^4 PF/cm^2	0.27–0.32	0.27–0.32
Junction Depth	0.4μ–0.6μ	0.2μ–0.4μ
P-Well Junction	2.5μ–3.5μ	
Poly P_S	15–30Ω/□	15–30Ω/□
Diffusion P_S	20–40Ω/□	60–100Ω/□
VTF Poly	>10$_V$	>10$_V$
ΔW	—1.0μ	—1.2μ
LEFF	1.0μ–1.4μ	1.3μ–1.7μ
Substrate Resistivity	2.5KΩ/□	1.2Ω/cm

Feature Size:3μ

	N-Channel	P-Channel
VTEO	0.5-1.0$_V$	0.5–1.0$_V$
BVDSS	>10$_V$	>10$_V$
$K^1 = \frac{\mu c}{2}$ linear region	18–21	6–8
B_E(Long Channel)	0.8–1.4$_V^{1/2}$	0.4—0.6$_V^{1/2}$
Cap. Gate 10^4 PF/cm^2	5.9–7.0	5.9– 7.0
Cap. Poly to Sub 10^4 PF/cm^2	0.45–0.55	0.45–0.55
Cap. Metal to Sub 10^4 PF/cm^2	0.2–0.25	0.2–0.25
Junction Depth	0.6μ–1.0μ	0.4μ–0.8μ
P-Well Junction	3.5μ–4.5μ	
Poly P_S	15–30Ω/□	15–30Ω/□
Diffusion P_S	10–30Ω/□	30–70Ω/□
VTF Poly	>10$_V$	>10$_V$
ΔW	—1.0μ	—1.0μ
LEFF	1.4μ–2.0μ	1.8μ–2.4μ
Substrate Resistivity	2.5KΩ/□	1.0–1.5Ω/cm

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CIRCLE NO 91

TRAINING
COURSE: A 5-day session is available prior to design commitment; course is offered in all design centers; $2500 per engineer.
DOCUMENTATION: Design manuals are available prior to design commitment; updated quarterly.

SUPPORT FACILITIES
Santa Clara, CA; Boston, MA; Bedford, UK; Stockholm, Sweden; Paris, France; and Munich, West Germany.

CYCLE TIMES
DESIGN: 1 to 2 weeks.
PROTOTYPING: 5 to 6 weeks.

INPUTS FOR COST ESTIMATION
Schematic, I/O count, production volume and schedule, technology.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
Motorola; alternate sourcing effected through layout-data transfer.

NCM Corp
1500 Wyatt Dr
Santa Clara, CA 95054
(408) 496-0290
Circle No 567

CUSTOMER/VENDOR INTERFACE
PREFERRED: Logic schematics.

WORKSTATION SUPPORT
Silicon Graphics Gemstation.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Test-program generation, testability analysis.
VENDOR PERFORMS: All aspects of logic design, chip layout and design verification; test generation at user's option.

TRAINING
COURSE: Course covers design and development.
DOCUMENTATION: CMOS design manual available.

CYCLE TIMES
PROTOTYPING: 6 to 10 weeks.

INPUTS FOR COST ESTIMATION
Schematics.

PRODUCTION COMMITMENTS
None.

NCR Corp
ASIC Product Marketing
2001 Danfield Ct
Fort Collins, CO 80525
(303) 226-9550
Circle No 568

CUSTOMER/VENDOR INTERFACE
PREFERRED: Basic specifications, schematics, verified net list, layout.

DESIGN TOOLS
Three levels of CAE options are available: 1) Schematic capture; 2) Schematic capture, simulation, timing analysis, and test generation; 3) Schematic capture, simulation, timing analysis, test generation, and layout.

WORKSTATION SUPPORT
Daisy, Mentor, Valid, and Cadnetics; Viewlogic will be supported in second qtr 1986; Tangent will be supported in third qtr 1986.

DESIGN CYCLE
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Initial specification, schematic capture, simulation, timing analysis, layout, back-annotation and resimulation, test-vector generation.
VENDOR PERFORMS: Tooling.

TRAINING
COURSE: Regularly scheduled semicustom and CAE courses available at customer's site.
DOCUMENTATION: Manuals and data sheets available.

SUPPORT FACILITIES
12 locations, including northern California; Fort Collins, CO; Colorado Springs, CO; Miamisburg, OH; and area sales offices.

CYCLE TIMES
DESIGN: 4 to 10 weeks.
PROTOTYPING: 2 to 4 weeks.

INPUTS FOR COST ESTIMATION
Block diagram, ac and dc specifications, schematics.

PRODUCTION COMMITMENTS
Negotiable; production commitment lowers engineering charges.

ALTERNATE SOURCES
Motorola.

NEC Electronics USA Inc
401 Ellis St
Mountain View, CA 94043
(415) 960-6000
Circle No 569

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list.
DISCOURAGED: Unsimulated schematic or net list.

DESIGN TOOLS
NEC's CAE system supports data entry, logic simulation, timing analysis, layout, fault simulation, and automatic test generation.

WORKSTATION SUPPORT
Daisy, Mentor, Valid, Futurenet, Tektronix/CAE, and Hewlett Packard.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN OR VENDOR'S TOOLS: Partitioning analysis, schematic capture, logic and timing simulation, design-rule check.
VENDOR PERFORMS: All other steps, from logic validation to mask design.

FUNCTION LIBRARIES
TTL: Library includes 30 functions built from as many as seven 3-input gates; users can define new functions using existing library elements or discrete gates; all functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.
ECL: Libraries include as many as 70 functions built from as many as 20 2-input gates; users can define new functions using existing library elements or discrete gates; all functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

CMOS: Each library includes 150 functions with maximum complexities equivalent to 20 2-input gates; users can define new functions using existing library elements or discrete gates; all functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

TRAINING
COURSE: On an individual basis.

SUPPORT FACILITIES
Sunnyvale, CA; Dallas, TX; and Natick, MA.

CYCLE TIMES
DESIGN: 2 to 4 weeks.
PROTOTYPING: 3 to 5 weeks.

INPUTS FOR COST ESTIMATION
Estimated cell count, I/O count, packaging, production volume.

PRODUCTION COMMITMENTS
None.

ALTERNATE SOURCES
None.

Oki Semiconductor
650 N Mary Ave
Sunnyvale, CA 94086
(408) 720-1900
Circle No 570

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated or unsimulated schematic or net list.
ACCEPTABLE: PG tape, functional block diagram.

DESIGN TOOLS
Design tools permit schematic capture, net-list generation, logic and timing simulation, fault simulation, test-program generation, and layout.

WORKSTATION SUPPORT
Mentor, Daisy.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Logic design, test-vector generation, schematic capture, net-list generation, logic simulation.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: All of the above.
VENDOR PERFORMS: Layout, fault simulation, test-program generation.

TRAINING
COURSE: 3-day course available; $2000 fee waived for customers.
DOCUMENTATION: Design manual available.

SUPPORT FACILITIES
Sunnyvale, CA; Stoneham, MA.

CYCLE TIMES
DESIGN: 2 to 3 weeks.
PROTOTYPING: 3 to 5 weeks.

INPUTS FOR COST ESTIMATION
Gate count, package, volume, special functions.

PRODUCTION COMMITMENTS
Negotiable.

Plessey Semiconductor Div
3 Whatney
Irvine, CA 92714
(714) 951-5212
Circle No 571

CUSTOMER/VENDOR INTERFACE
PREFERRED: Customer performs entire design process and submits layout data.

DESIGN TOOLS
Plessey's CAE system runs on local DEC VAX minicomputers. The software supports chip planning, logic design, simulation, automatic routing and post-routing analysis.

WORKSTATION SUPPORT
Case, Futurenet, Daisy, Mentor.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN OR VENDOR'S TOOLS: Logic design, simulation, timing analysis, fault analysis, layout, post-layout simulation, test-program generation.
VENDOR PERFORMS: CAE training, design support.

FUNCTION LIBRARIES
CMOS: Library includes 60 functions built from as many as six 2-input gates; users can define new functions using existing library elements or discrete gates; all cells have been built and tested; simulation parameters include ID, LD, SUH, TS, VS, FI, and FO.
ECL: Library includes 30 functions built from as many as six 2-input gates; users must employ only predefined library elements; all cells have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

TRAINING
COURSE: A 3-day session available for software licensees at the company's design centers or at the customer's site.
DOCUMENTATION: Documentation available to users of company's design software.

SUPPORT FACILITIES
Irvine, CA; Silicon Development Corp in Boston, MA.

CYCLE TIMES
DESIGN: 2 to 6 weeks.
PROTOTYPING: 6 to 10 weeks.

INPUTS FOR COST ESTIMATION
Schematic, critical-path timing, I/O specification, packaging.

PRODUCTION COMMITMENTS
None required.

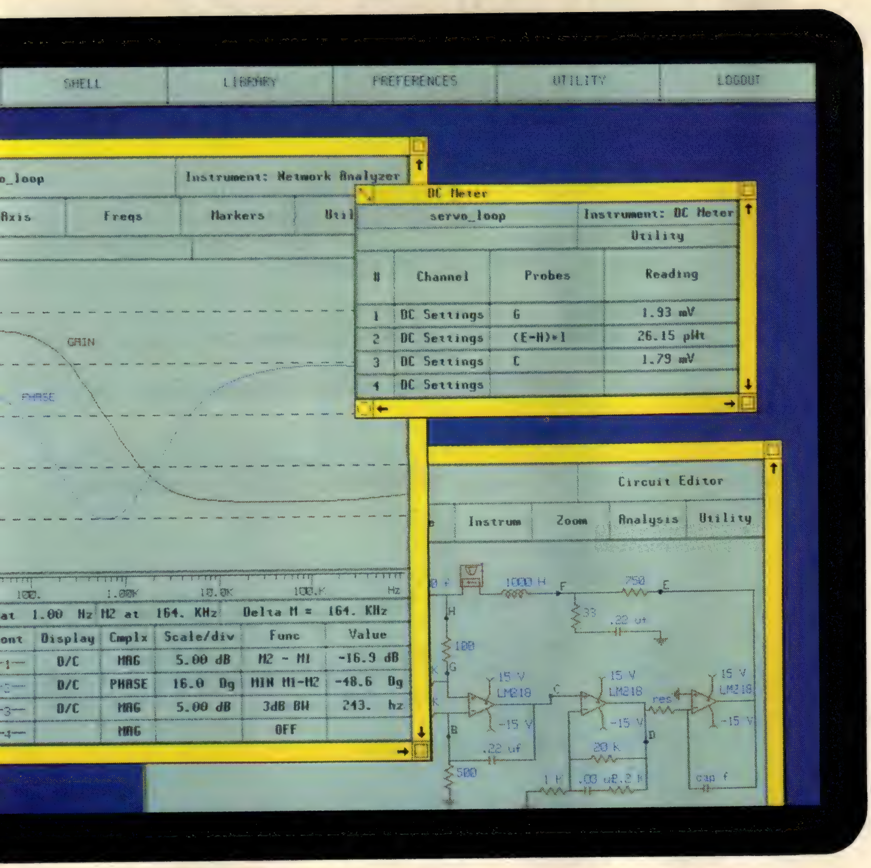
Polycore Electronics
1107 Tourmaline
Newbury Park, CA 91320
(805) 499-6777
Circle No 572

CUSTOMER/VENDOR INTERFACE
PREFERRED: Functional block diagram.

DESIGN TOOLS
Spice.

WORKSTATION SUPPORT
None.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Functional design.
VENDOR PERFORMS: All other design tasks.



#	Channel	Probes	Reading
1	DC Settings	G	1.93 mV
2	DC Settings	(E-H)*1	26.15 pWt
3	DC Settings	C	1.79 mV
4	DC Settings		

at 1.00 Hz M2 at 164. KHz Delta M = 164. KHz

ont	Display	Cmplx	Scale/div	Func	Value
-1-	D/C	MAG	5.00 dB	M2 - M1	-16.9 dB
-2-	D/C	PHASE	16.0 Dg	MIN M1-M2	-48.6 Dg
-3-	D/C	MAG	5.00 dB	3dB BW	243. hz
-4-		MAG		OFF	

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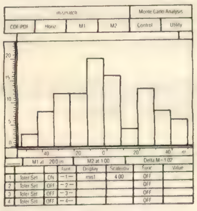
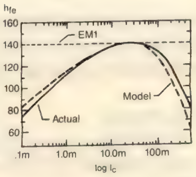
The Analog Workbench™ is *the* Analog CAE system truly suited to the unique needs of analog designers. The reason? It was conceived by analog designers.

That's why it has the most complete set of analyses on the market.

For example, consider our Monte Carlo Analysis to predict manufacturability. Or our Sensitivity/Worst Case Analysis to determine which component values most affect circuit performance. And the Parametric Plotter that lets the designer do "what if" analyses on circuit performance.



Monte Carlo Analysis predicts manufacturability.



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You can design with a library of nearly 700 semiconductors and integrated circuits. That, combined with our own SPICE PLUS™ simulator, provide the most accurate circuit simulation available.

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Our software runs on Apollo, HP and SUN workstations. And all these features are also available on the new PC Workbench,™ an IBM PC version of the Analog Workbench.

So give us a call. We'll tell you more about the special features of the Analog Workbench. Or just talk analog design. From one analog designer to another. Analog Design Tools, Inc., 66 Willow Place, Menlo Park, CA 94025, (415) 328-0780.

The Analog Workbench, PC Workbench and SPICE PLUS are trademarks of Analog Design Tools, Inc.

ANALOG
DESIGN
TOOLS

CIRCLE NO 92

TRAINING
COURSE: None.

Raytheon Semiconductor
350 Ellis St
Mountain View, CA 94039
(415) 968-9211
Circle No 573

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated or unsimulated net list or schematic.
ACCEPTABLE: Functional block diagram, layout data, PG tape.

DESIGN TOOLS
Vendor provides CAE for schematic capture, net-list generation, simulation, fault grading, layout, and test generation for digital designs. Linear designs require Spice simulation.

WORKSTATION SUPPORT
Mentor, Daisy.

DESIGN CYCLE
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Logic design, simulation, net-list generation, fault grading.
VENDOR PERFORMS: Above at customer's discretion, layout.

FUNCTION LIBRARIES
CMOS: Library contains 100 SSI and MSI functions.
BIPOLAR: Libraries contain 25 MSI functions.

TRAINING
COURSE: 2-day tutorial is available for $6000.
DOCUMENTATION: Design manuals available upon design commitment.

SUPPORT FACILITIES
Mountain View, CA.

CYCLE TIMES
DESIGN: 4 to 8 weeks.
PROTOTYPING: 4 to 6 weeks.

INPUTS FOR COST ESTIMATION
Gate count, pin count, critical speed or clock frequency, temperature range.

PRODUCTION COMMITMENTS
None.

RCA Solid State Div
Route 202
Somerville, NJ 08876
(201) 685-6218
Circle No 574

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated net list, layout data generated by vendor's software, PG tapes.
DISCOURAGED: Functional block diagram.

DESIGN TOOLS
Users gain access to the software through Tymnet from remote alphanumeric terminals.

WORKSTATION SUPPORT
Daisy, Mentor, Valid, DEC VAX, and Apollo.

DESIGN CYCLE
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Logic design, simulation, test-vector generation.
VENDOR PERFORMS: Layout, post-layout analysis, test-program generation.

FUNCTION LIBRARY
Cell complexity depends on user's requirements; library cells combine predefined models and user-customized building blocks; all basic component models have been tested; simulation parameters include ID, LD, SUH, VS, TS, FI, and FO.

TRAINING
COURSE: A 3-day session is offered in vendor's design centers.
DOCUMENTATION: Design manuals available as part of course.

SUPPORT FACILITIES
Somerville, NJ; Santa Clara, CA; Brussels, Belgium; Hong Kong; Paris, France; Sunbury, UK; Quickborn, West Germany; and Solna, Sweden.

CYCLE TIMES
DESIGN: Depends on customer.
PROTOTYPING: 6 to 8 weeks.

INPUTS FOR COST ESTIMATION
Logic diagram or gate count, I/O count and specification, package, temperature range, clock frequency.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
LSI Logic; alternate sourcing effected through PG-tape transfer.

Sahni Corp
224 N Wolfe Rd
Sunnyvale, CA 94086
(408) 735-8900
Circle No 575

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list, layout data generated by vendor's software.
DISCOURAGED: Functional block diagram, unsimulated schematic or net list, layout data generated using customer's software, manual layout data.

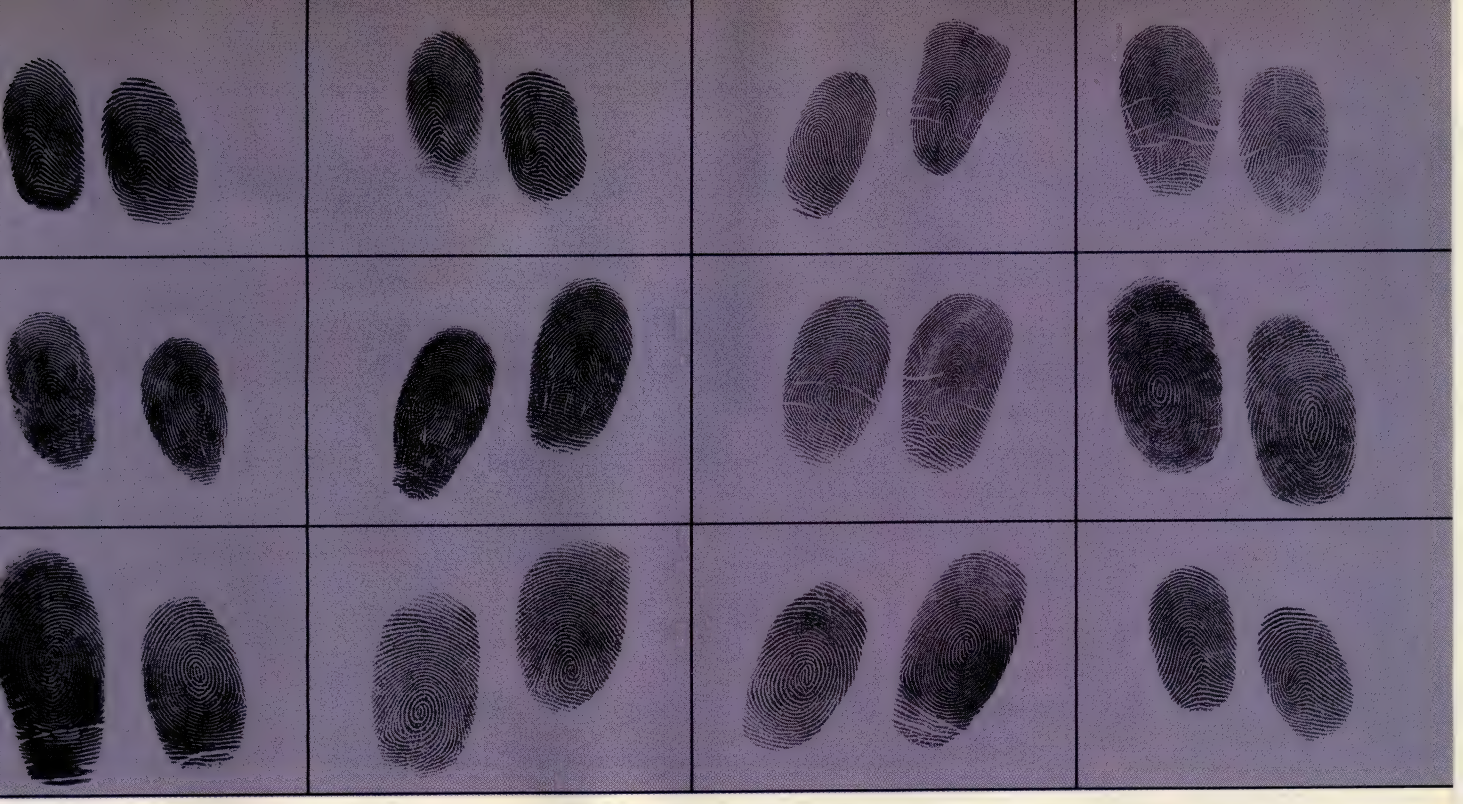
DESIGN TOOLS
Vendor uses VTI design tools and proprietary IBM PC-based tools. Kit parts for linear arrays are available for breadboarding.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, testability analysis, logic design, simulation, and timing and critical-path analysis.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Building breadboard, simulation, layout, custom-cell creation.
VENDOR PERFORMS: Layout, other steps at customer's option.

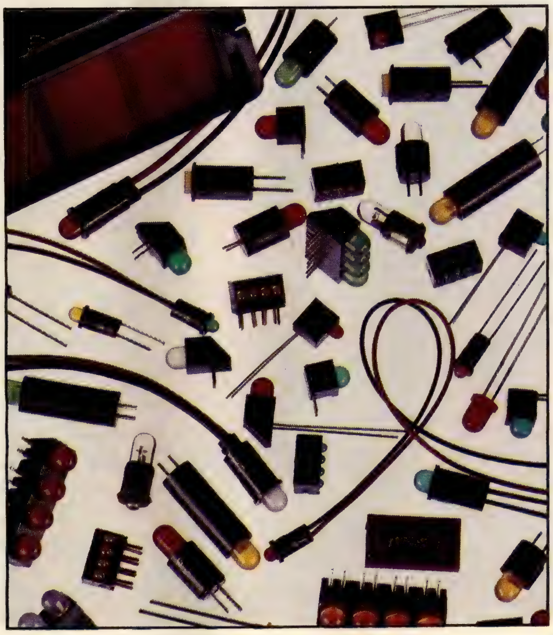
TRAINING
COURSE: Training available prior to design commitment.
DOCUMENTATION: Design manuals available prior to design commitment.

SUPPORT FACILITIES
Sunnyvale, CA.

CYCLE TIMES
DESIGN: 1 to 10 weeks.
PROTOTYPING: 2 to 6 weeks.



BECAUSE NO TWO ENGINEERS ARE EXACTLY ALIKE, DIALIGHT OFFERS THE LARGEST OPTOELECTRONICS VARIETY.



With everything electronic getting smaller, PC boards and front panels are getting more complicated and difficult to service.

Fortunately, Dialight optoelectronics can help throw some light on the subject. And that's why using this technology is becoming the mark of a good design engineer.

THE ABCs OF DESIGNING WITH LEDs.

Suppose you want to backlight a front panel from an internal PC board.

You could use value-added Dialight LEDs. They plug right into the board and hold the light steady at exactly the right distance from the panel.

Or you can make troubleshooting a circuit board easy by designing in a Dialight LED that will indicate a faulty component.

Dialight packages LEDs to make them easier to insert. With no need to bend, trim, and possibly break, delicate leads.

Of course, you could buy individual LEDs for less. And have somebody bend, trim and insert them by hand. But think of what all that hand labor costs. Not to mention the cost of a service call if your light fails in the field.

That's what made the value-added LED such a good idea when we came up with it almost 15 years ago. And why we still 100% test every single LED before we ship it.

AN IDEA THAT'S 4 TIMES BRIGHTER.

Today Dialight is still lighting the way. Our new Super Brights, for example, are 4 times brighter than ordinary LEDs. So they're easier to see. Even in the high ambient light of a computer room. And if you're short on power, they operate on one-fourth the current.

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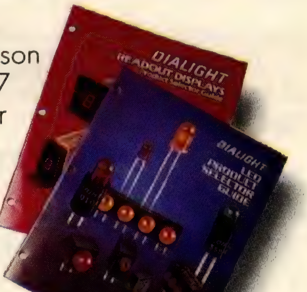

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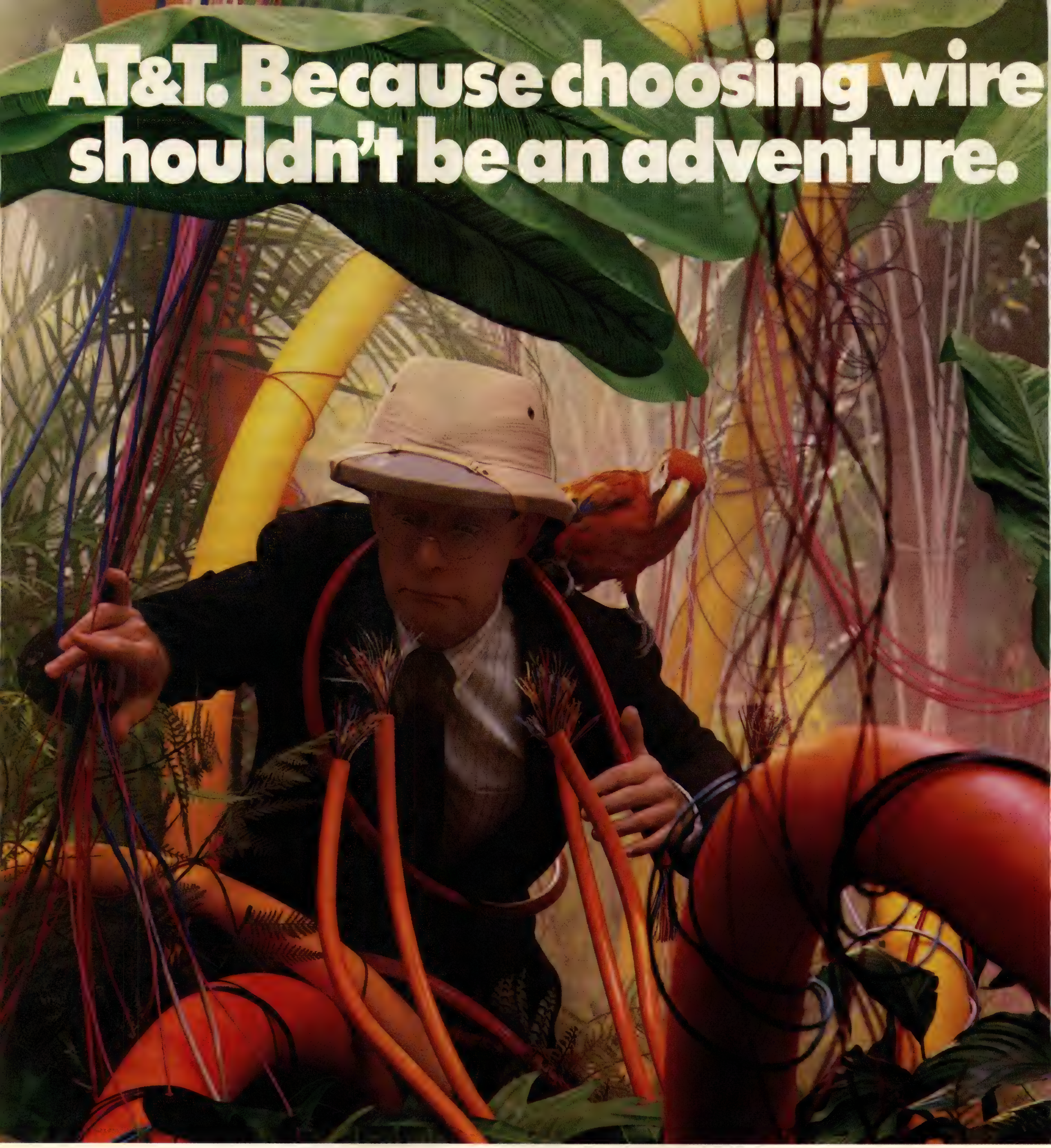
DIALIGHT OPTOELECTRONICS

Products of your imagination.

CIRCLE NO 93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CIRCLE NO 94

INPUTS FOR COST ESTIMATION
Packaging, gate count or logic diagram, amount of analog and digital circuitry, screening, volume.

PRODUCTION COMMITMENTS
None.

SGS Semiconductor Corp
1000 E Bell Rd
Phoenix, AZ 85022
(602) 867-6264

SGS Microelettronica SpA
Via Carlo Olivetti 2
20041 Agrate Brianza
Italy
(039) 65551
Circle No 576

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated net list or schematic.
DISCOURAGED: Functional block diagram.

DESIGN TOOLS
SGS uses LDS III software running on an IBM mainframe.

WORKSTATION SUPPORT
Daisy, Mentor, Valid.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, logic design, truth tables, and timing specification.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Simulation, timing analysis, critical-path analysis, testability analysis, test-program generation.
VENDOR PERFORMS: Layout, post-layout simulation and timing analysis, tooling.

TRAINING
COURSE: A 4-day course is available.
DOCUMENTATION: Available.

SUPPORT FACILITIES
Milan, Italy; Munich, West Germany; London, UK; Stockholm, Sweden; Paris, France; Phoenix, AZ; and Singapore.

CYCLE TIMES
DESIGN AND PROTOTYPING: 7 to 10 weeks.

INPUTS FOR COST ESTIMATION
Complexity, packaging, volume, temperature, screening.

PRODUCTION COMMITMENTS
None.

Siemens AG
Balanstr 73
D 8000 München 80
West Germany
(089) 4144-4253
Circle No 577

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated net list.
DISCOURAGED: Block diagram, unsimulated net list or schematic, PG tapes.

DESIGN TOOLS
Proprietary Venus CAD system.

WORKSTATION SUPPORT
Daisy, Valid.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Schematic capture, net-list generation.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Logic design, simulation, layout, test-program generation.
VENDOR PERFORMS: Layout, post-layout analysis, test-program generation.

TRAINING
COURSE: A course that varies in length between 2 and 5 days is available in Munich, West Germany.
DOCUMENTATION: Design manuals and cell libraries available on request.

SUPPORT FACILITIES
Munich, West Germany.

CYCLE TIMES
DESIGN: 3 to 8 weeks.
PROTOTYPING: 3 to 8 weeks.

INPUTS FOR COST ESTIMATION
Gate count, pin count, package, critical paths.

PRODUCTION COMMITMENTS
Depending on array type and complexity.

Signetics Corp
811 E Arques Ave
Sunnyvale, CA 94086
(408) 991-2000
Circle No 578

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated net list, database tape.
DISCOURAGED: Functional block diagram.

DESIGN TOOLS
CAE software supports logic-rule check, timing analysis, and fault grading.

WORKSTATION SUPPORT
Mentor, Daisy, and Futurenet.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, functional simulation.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Schematic capture, logic-rules checking, simulation, test-program generation.
VENDOR PERFORMS: Layout, fault grading.

FUNCTION LIBRARIES
ECL: Library contains over 120 functions ranging in complexity from simple gates to 4-bit counters.

TRAINING
COURSE: A 4-day course is available; it costs between $1000 and $2000.
DOCUMENTATION: Design manuals covering workstation use, design rules, library cells, testability, and packaging are available.

SUPPORT FACILITIES
Itasca, IL; Littleton, MA; and Sunnyvale, CA.

CYCLE TIMES
DESIGN: 1 to 4 weeks.
PROTOTYPING: 8 to 12 weeks.

INPUTS FOR COST ESTIMATION
Logic schematic, volumes.

PRODUCTION COMMITMENTS
Negotiable.

Silicon Systems Inc
14531 Myford St
Tustin, CA 92680
(714) 731-7110
Circle No 579

CUSTOMER/VENDOR INTERFACE
PREFERRED: Functional block diagram, simulated or unsimulated schematic or net list, layout data generated by vendor's software.
DISCOURAGED: Layout data generated by customer's software, PG tapes.

DESIGN TOOLS
SSI's CAE tools run on local minicomputers and support logic design, simulation and automatic standard-cell placement and routing. The system accepts data in schematic or net-list form.

WORKSTATION SUPPORT
Daisy, Mentor.

PRODUCTION COMMITMENTS
Estimate of 18-month production volumes.

ALTERNATE SOURCES
Plessey and MCE Semiconductors Inc.

Siliconix Inc
2201 Laurelwood Rd
Santa Clara, CA 95054
(408) 970-4107
Circle No 580

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list.

DESIGN TOOLS
Logic design and simulation on workstations; timing verification and layout on IBM mainframe.

WORKSTATION SUPPORT
Futurenet, Mentor, Daisy.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Schematic capture, logic verification.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Logic simulation, timing verification.
VENDOR PERFORMS: Layout, post-layout simulation.

FUNCTION LIBRARY
Library includes 125 functions built from as many as 24 2-input gates; users can define new functions using existing library elements and discrete gates; all cells have been fabricated and tested; simulation parameters include ID, LD, SUH, PD, FI, and FO.

TRAINING
COURSE: None offered.

SUPPORT FACILITIES
Santa Clara, CA; Boston, MA; and Swansea, UK.

CYCLE TIMES
DESIGN: 2 to 6 weeks.
PROTOTYPING: 4 to 8 weeks.

INPUTS FOR COST ESTIMATION
Array type, gate count, package type, screening requirements.

PRODUCTION COMMITMENTS
Only for guaranteed delivery.

ALTERNATE SOURCES
Universal Semiconductor Inc, Array Technology Corp; alternate sourcing effected through PG-tape transfer. Western Digital Inc serves as an alternate wafer source.

Sorep SA
ZJ Bellevue
BP5 35220 Chateaubourg
France
(33) 99623955
Circle No 581

DESIGN TOOLS
Design tools run on VAX 11/750.

TRAINING
COURSE: A 5-day course is available.

CYCLE TIMES
DESIGN: 6 to 8 weeks.
PROTOTYPING: 6 to 8 weeks from PG tape.

STC Microtechnology
2270 S 88th St
Louisville, CO 80027
(303) 673-5151
Circle No 582

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list, layout data generated by vendor's software.
ACCEPTABLE: Unsimulated schematic or net list.

DESIGN TOOLS
STC's CAE system supports design entry and simulation tasks. Users enter data through remote alphanumeric terminals.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, block-level functional simulation, logic design and minimization.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Critical-path analysis.
VENDOR PERFORMS: Logic simulation, timing analysis, testability analysis, fault grading, test-program generation, automatic gate-array placement and routing, post-routing simulation.

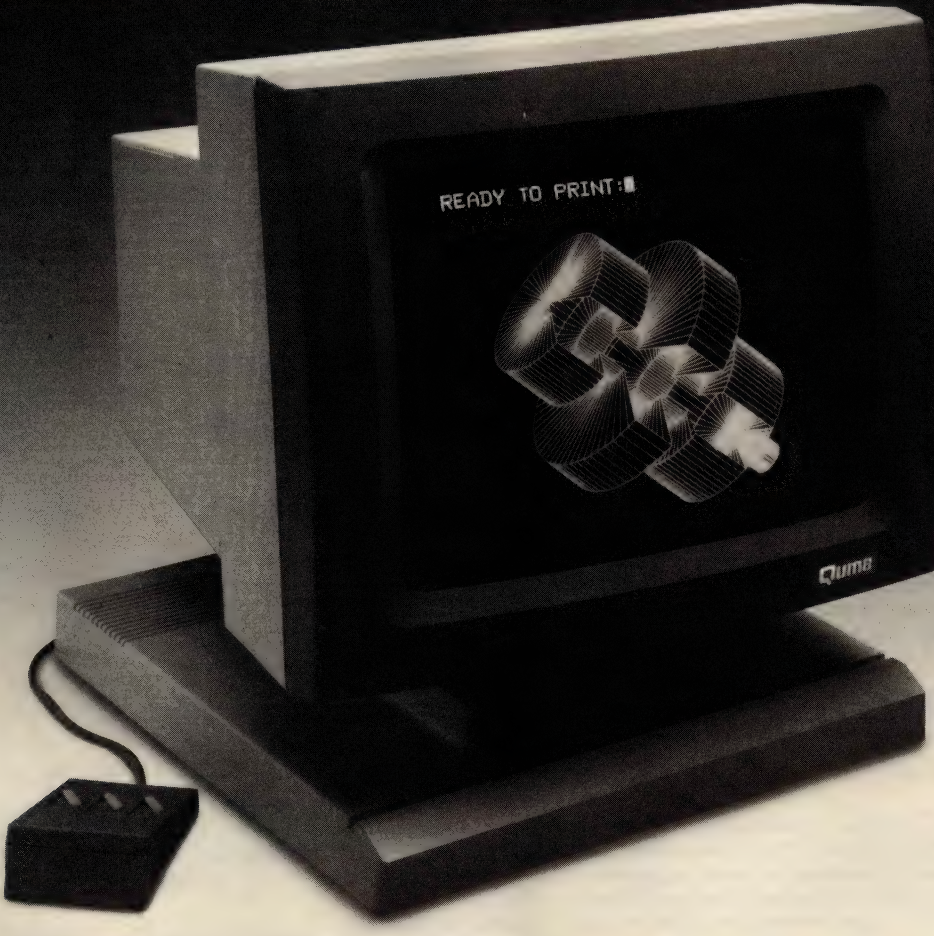
FUNCTION LIBRARY
Library includes 43 functions composed of as many as 15 2-input logic gates; users can define new functions using existing library elements; all library cells have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, FI, and FO.

TRAINING
COURSE: None offered.
DOCUMENTATION: Design manuals are available prior to design commitment; $100.

SUPPORT FACILITIES
Louisville, CO.

CYCLE TIMES
DESIGN: 6 to 8 weeks.
PROTOTYPING: 6 to 8 weeks.

Who says paper is passé in the age of CAD/CAE?



The computer has certainly brought design and engineering into the 20th century. But business is still done on paper.

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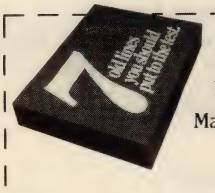

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Title__________
Company__________
Address__________
City__________ State____ Zip______

INPUTS FOR COST ESTIMATION
Circuit size, package type.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
None.

Telmos Inc
740 Kifer Rd
Sunnyvale, CA 94086
(408) 732-4882
Circle No 583

CUSTOMER/VENDOR INTERFACE
PREFERRED: Schematic, logic diagram, net list.
DISCOURAGED: Breadboard, functional block diagram, layout data, PG-tapes.

DESIGN TOOLS
Daisy workstation tools support front-end design; Calma and Dracula software supports back-end design.

WORKSTATION SUPPORT
Daisy, Calma.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Schematic capture, logic design.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Schematic capture, analog and digital simulation and verification, test-pattern and test-program generation, breadboard development.

FUNCTION LIBRARIES
Libraries includes 100 functions built from as many as 50 2-input gates; users can define new cells using existing library elements or discrete gates; 85 to 90% of each library has been built and tested; simulation parameters include ID, LD, SUH, VS, TS, FI, and FO.

TRAINING
COURSE: Training tailored to customer's needs.
DOCUMENTATION: Design manuals are available without design commitment for $70.

SUPPORT FACILITIES
KMOS in Santa Clara, CA; Timark in Indianapolis, IN; Silicon Development Corp in Huntington Beach, CA and Wakefield, MA; Integration SA in France; Dainichi Electronics in Japan; Sagantes bv in the Netherlands; Nordic VLSI in Norway; Chartered-Telmos Design Ltd in Singapore; Sicon AB in Sweden; and GME in West Germany.

CYCLE TIMES
DESIGN: 2 to 12 weeks.
PROTOTYPING: 3 to 4 weeks.

INPUTS FOR COST ESTIMATION
Maximum clock frequency, operating voltage, pin count, package type, delivery, volume.

PRODUCTION COMMITMENTS
None.

ALTERNATE SOURCES
California Devices Inc.

Tektronix Integrated Circuits Operation
Box 500, M/S 59-420
Beaverton, OR 97077
(503) 627-2515
Circle No 584

CUSTOMER/VENDOR INTERFACE
PREFERRED: Layout data generated by vendor's software, Spice net list.
ACCEPTABLE: Layout data in Calma or Applicon format, hand-drawn layout on gridded plot.

DESIGN TOOLS
A proprietary graphics editor serves as a front end to Tspice.

WORKSTATION SUPPORT
Layout data for Calma and Applicon.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Design, simulation, layout.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Layout.
VENDOR PERFORMS: Design-rule check, layout verification, tooling.

TRAINING
COURSE: 2-day course included in design fees.
DOCUMENTATION: Design guide and process specifications are available upon design commitment.

SUPPORT FACILITIES
Beaverton, OR.

CYCLE TIMES
DESIGN: Customer determined.
PROTOTYPING: 3 weeks.

INPUTS FOR COST ESTIMATION
Testing, packaging.

PRODUCTION COMMITMENTS
None.

Texas Instruments Inc
Box 225474
8390 LBJ Freeway
Dallas, TX 75265
Phone local sales office.
Circle No 585

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated schematic or net list, logic and test data.
ACCEPTABLE: Functional block diagram, unsimulated schematic or net list, layout data, tooling database.

DESIGN TOOLS
Schematic capture and simulation occurs on workstations.

WORKSTATION SUPPORT
Daisy, Mentor, Valid, and P-Cad.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis, functional simulation, logic design and simulation, timing analysis, testability analysis, test-program generation, fault-grading, layout, post-layout simulation.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Functional simulation, logic design and simulation, timing analysis, test-pattern generation.
VENDOR PERFORMS: Custom cell creation, network-equivalency check; logic and post-routing simulation as data check; layout tasks at customer's option.

FUNCTION LIBRARIES
Libraries include 100 functions using as many as 60 2-input NAND gates; users can define new functions based on existing library elements; all functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, FI, and FO.

TRAINING
COURSE: A 3-day session is offered at all regional technology centers; tuition is refunded upon design commitment.
DOCUMENTATION: Manuals available without design commitment.

SUPPORT FACILITIES
Chicago, IL; Boston, MA; Atlanta, GA; Dallas, TX; Santa Clara, CA; Irvine, CA; Ottawa, Ontario, CA; Europe; and Japan.

CYCLE TIMES
DESIGN: 3 to 6 weeks.
PROTOTYPING: 4 to 6 weeks.

INPUTS FOR COST ESTIMATION
Gate and I/O counts, package type, drive requirements, volume.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
Fujitsu. All alternate sourcing effected through PG-tape transfer.

TLSI Inc
790 Park Ave
Huntington, NY 11743
(516) 549-6300
Circle No 586

CUSTOMER/VENDOR INTERFACE
PREFERRED: Logic diagram, schematic, specification.

WORKSTATION SUPPORT
Daisy.

SUPPORT FACILITIES
Huntington, NY.

CYCLE TIMES
DESIGN: 2 to 8 weeks.
PROTOTYPING: 6 weeks.

INPUTS FOR COST ESTIMATION
Logic diagram or funtional block diagram.

PRODUCTION COMMITMENTS
Preferred.

Toshiba America
1220 Midas Way
Sunnyvale, CA 94086
(408) 733-3223
Circle No 587

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated or unsimulated schematic or net list.
DISCOURAGED: PG tapes.

DESIGN TOOLS
Toshiba's CAE system includes simulation, layout, and test-program generation.

WORKSTATION SUPPORT
Daisy, Mentor, Valid, Futurenet.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Schematic capture.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Schematic capture and simulation.
VENDOR PERFORMS: Layout and simulation.

FUNCTION LIBRARIES
Users can build new functions from library elements or discrete gates; all functions have been built and tested; simulation parameters include ID, LD, SUH, VS, TS, PD, FI, and FO.

TRAINING
DOCUMENTATION: Design manuals are available upon request.

SUPPORT FACILITIES
Burlington, MA; Dallas, TX; and Sunnyvale, CA.

CYCLE TIMES
DESIGN: 2 to 5 weeks.
PROTOTYPING: 4 to 6 weeks.

INPUTS FOR COST ESTIMATION
Gate count and package.

PRODUCTION COMMITMENTS
Negotiable.

ALTERNATE SOURCES
LSI Logic; alternate sourcing effected through transfer of PG tape, layout data, or net list.

Triquint Semiconductor
Group 700, Box 4935
Beaverton, OR 97075
(503) 629-4227
Circle No 588

CUSTOMER/VENDOR INTERFACE
PREFERRED: Net list.
DISCOURAGED: Schematic.

DESIGN TOOLS
Tools provide schematic capture, simulation, and net-list generation.

WORKSTATION SUPPORT
Daisy, Tektronix/CAE.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Design, simulation, net-list generation.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Design, simulation, net-list generation.
VENDOR PERFORMS: Layout, back annotation and resimulation.

FUNCTION LIBRARIES
Library includes 55 macrocells including I/O cells that support CMOS, ECL, and TTL I/O signal levels.

TRAINING
DOCUMENTATION: Designer's guide, library documentation, workstation user's guide, evaluation kit.

SUPPORT FACILITIES
Beaverton, OR.

CYCLE TIMES
DESIGN: 2 to 4 weeks.
PROTOTYPING: 8 to 12 weeks.

INPUTS FOR COST ESTIMATION
NRE fixed for 10 prototypes.

PRODUCTION COMMITMENTS
None.

With this high-performance GCR Streamer, the benefits begin with reliability and end with cache.

That's the advantage you get with a leader.

At Fujitsu America we want our back-up devices to be second-to-none in price, performance and reliability.

That's why we developed the M244X series ½" GCR tape drive with an intelligent 256KB cache buffer. The buffer means you get all the versatility of our start/stop drive, plus the speed and reliability of our streamer technology. Parameters such as transfer rate, block size and ramp times are all switch-selectable so you can easily optimize the drive for your system.

But the cache buffer is just the finishing touch on a tape drive that already outperforms the competition.

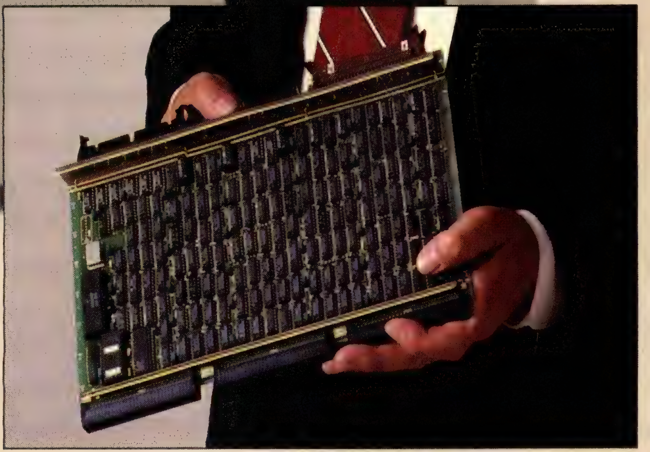
By incorporating Fujitsu's advanced LSI electronics, we have eliminated the high-cost, high-failure mechanics found in other low-cost GCR tape drives. As a result, you get a high-performance GCR Streamer with the best reliability rating—and the best price—in its class.

Throughout this drive's design, we have found ways to keep your cost of ownership to a minimum. The drive performs its own internal monitoring and self-adjustment, eliminating costly preventative maintenance. And the sophisticated diagnostics make it possible to isolate system faults without special test equipment.

For information on this or any other Fujitsu tape drive, call (408) 946-8777. Or write Fujitsu America, Inc., Storage Products Division, 3055 Orchard Drive, San Jose, CA 95134-2017.

The Fujitsu M244XAC GCR Streamer, with cache buffer. From price, to performance, to reliability—it's the best tape drive in its class.

MODEL	M2442AC	M2444AC
Tape Speed (ips)		
Streaming	100	75
Start/Stop	12.5	25
Recording Density (bpi)	6250/1600	
MTBF	8,000 hours	
Cache Buffer	256 KB	
Transfer Rate	Selectable from 60 KB/sec to 1 MB/sec	
Compatibility	IBM® ECMA and ANSI	
Interface	Cipher® Pertec compatible	



Fujitsu Cache Adapter provides a 256KB intelligent memory buffer, increasing system performance.

We're developing technology for you.

FUJITSU

FUJITSU AMERICA

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Cipher is a registered trademark of Cipher Data Products, Inc.

CIRCLE NO 97

Universal Semiconductor Inc
1925 Zanker Rd
San Jose, CA 95112
(408) 279-2830
Circle No 589

CUSTOMER/VENDOR INTERFACE
PREFERRED: Layout data generated by vendor's software.
ACCEPTABLE: Simulated schematic or net list, layout data generated by customer's software.
DISCOURAGED: Functional block diagram, unsimulated schematic or net list.

DESIGN TOOLS
Universal Semiconductor offers a CAE system that runs on an IBM PC and supports design-entry logic simulation and timing verification.

WORKSTATION SUPPORT
Daisy, Mentor, Valid.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning analysis.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Functional simulation, logic design and simulation, timing analysis.
VENDOR PERFORMS: Testability analysis, test-program generation, fault grading, chip layout, post-layout analysis.

FUNCTION LIBRARIES
Libraries include 35 functions; most complex cell employs 60 2-input gates; users can define and store functions built from predefined cells or from discrete gates; 90% of all library cells have been built and tested; simulation parameters include ID, LD, VS, TS, PD, FI, and FO.

TRAINING
COURSE: A 3-day session is available without design commitment and is offered in San Jose, CA; $500.
DOCUMENTATION: Design manuals are available without design commitment; $70, updated semiannually.

SUPPORT FACILITIES
Los Angeles, CA; Boca Raton, FL; Ottawa, Ontario, Canada; and Dallas, TX.

DESIGN CYCLE
DESIGN: 3 to 5 weeks.
PROTOTYPING: 1 to 2 weeks.

INPUTS FOR COST ESTIMATION
Gate and pin counts, package style, operating frequency.

PRODUCTION COMMITMENTS
None required.

ALTERNATE SOURCES
Siliconix Inc; alternate sourcing effected at any level. Western Digital Inc serves as an alternate wafer source.

Vatic Systems Inc
761 E University
Mesa, AZ 85203
(602) 962-8998
Circle No 590

CUSTOMER/VENDOR INTERFACE
PREFERRED: Net list.
DISCOURAGED: Layout.

DESIGN TOOLS
VSI's CAE tools include GenRad front-end design software and Silvar-Lisco layout software.

WORKSTATION SUPPORT
Daisy, Mentor, and Valid.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Schematic capture, simulation.
CUSTOMER PERFORMS USING VENDOR'S TOOLS: Schematic capture, simulation, layout.
VENDOR PERFORMS: All steps.

FUNCTION LIBRARIES
CMOS: Library includes 75 functions built from as many as six 2-input gates; all functions have been built and tested.
ECL/TTL: Library includes 90 functions built from as many as 10 2-input gates; 70% of all functions have been built and tested.

TRAINING
COURSE: A 3-day training course is available at either Mesa, AZ or at customer's site.
DOCUMENTATION: A design manual is available.

SUPPORT FACILITIES
Mesa, AZ; Boston, MA; and San Jose, CA.

CYCLE TIMES
DESIGN: 6 weeks.
PROTOTYPING: 6 weeks.

INPUTS FOR COST ESTIMATION
Gate count.

PRODUCTION COMMITMENTS
None.

ALTERNATE SOURCES
CMOS: Oki Semiconductor.

VTC Inc
2401 E 86th St
Box 201559
Bloomington, MN 55420
(612) 854-8830
(800) 352-6789
Circle No 591

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated design.

WORKSTATION SUPPORT
Mentor.

TRAINING
COURSE: Training course available on videocassette.
DOCUMENTATION: Data sheets, user's guide, design manual and notes, and evaluation chips and data sheets.

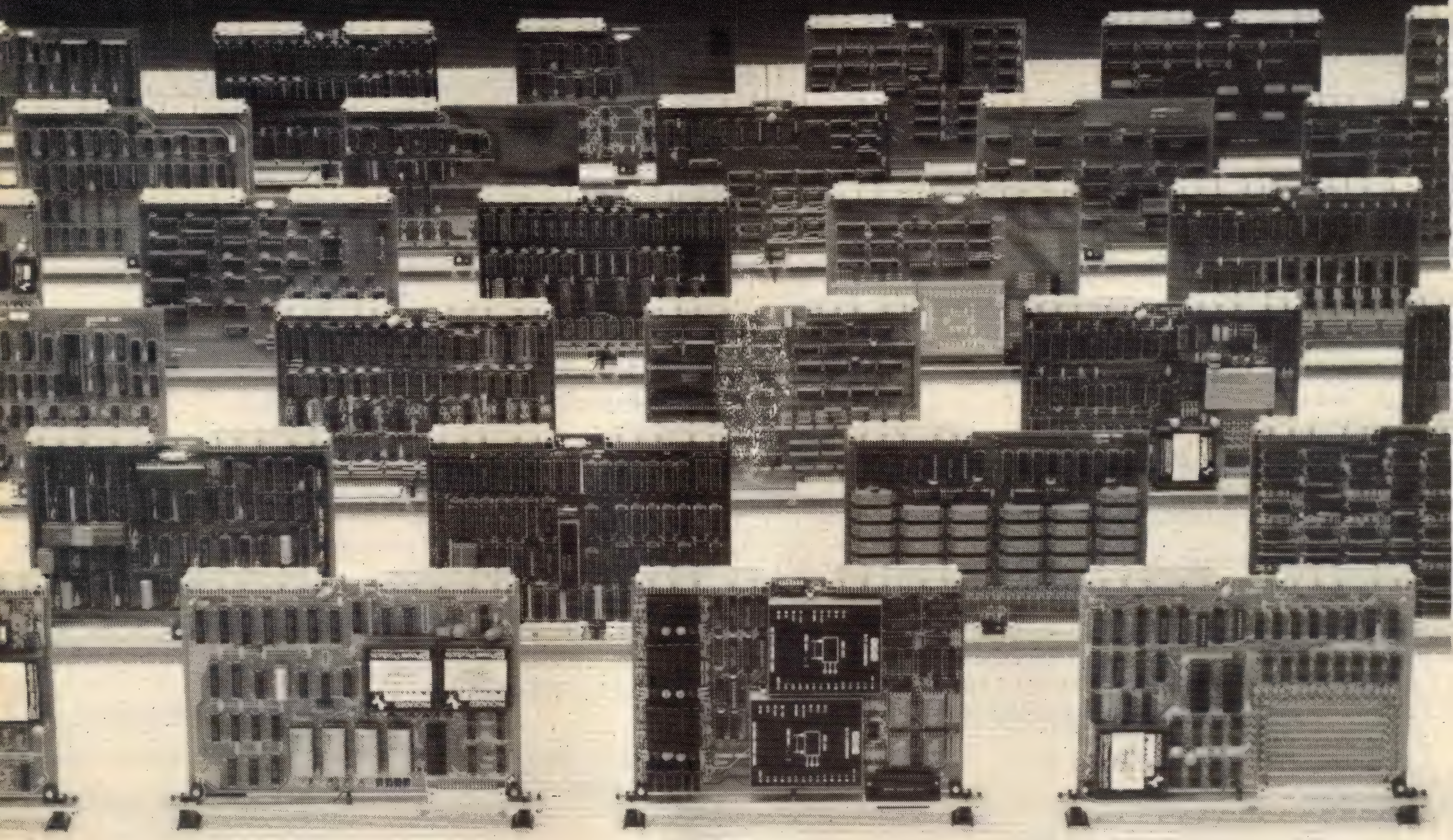
CYCLE TIMES
DESIGN: 4 weeks.
PROTOTYPING: 8 weeks.

PRODUCTION COMMITMENTS
One year commitment.

VLSI Technology Inc
1109 McKay Dr
San Jose, CA 95131
(408) 434-3000
Circle No 592

CUSTOMER/VENDOR INTERFACE
PREFERRED: Simulated net list and test vectors.
ACCEPTABLE: Unsimulated schematic or net list and test vectors.

"LEADING THE INDUSTRY IN VME SOLUTIONS



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- ☐ DIGITAL I/O
- ☐ ANALOG I/O
- ☐ CHANGE-OF-STATE
- ☐ COUNTER/PULSE RATE
- ☐ SERIAL I/O
- ☐ SYNCHRO/RESOLVER
- ☐ ANALOG BACKPLANES
- ☐ SYNCHRO BACKPLANES
- ☐ INTELLIGENT I/O CONTROLLERS
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VMIC™

VME MICROSYSTEMS INTERNATIONAL CORPORATION

12021-N South Memorial Parkway
Huntsville, AL 35803
(205) 880-0444

CIRCLE NO 98

DIRECTORY

DESIGN TOOLS
Vendor's software supports schematic capture, logic and timing verification, and post-layout verification. Tools run on Apollo, VAX, MicroVAX, ELXSI, Ridge, and Wang systems.

WORKSTATION SUPPORT
Daisy, Mentor, Hewlett Packard.

DESIGN CYCLE
CUSTOMER PERFORMS USING OWN TOOLS: Partitioning.
CUSTOMER PERFORMS USING OWN OR VENDOR'S TOOLS: Schematic capture, logic and timing verification, post-layout simulation.
VENDOR PERFORMS: Layout, net-list comparison, post-layout verification.

FUNCTION LIBRARIES
Library includes over 100 functions, including scan-path macros; users can define new functions based on existing elements; all functions have been built and tested; simulation parameters include ID, LD, SUH, TS, VS, PD, FI, and FO.

TRAINING
COURSE: 3-, 5-, and 10-day courses available at regional design centers.
DOCUMENTATION: Design and training manuals available.

SUPPORT FACILITIES
San Jose, CA; Boston, MA; Dallas, TX; Irvine, CA; Chicago, IL; Munich, West Germany; and Ivera, Italy.

CYCLE TIMES
DESIGN: 1 to 10 weeks.
PROTOTYPING: 3 to 6 weeks.

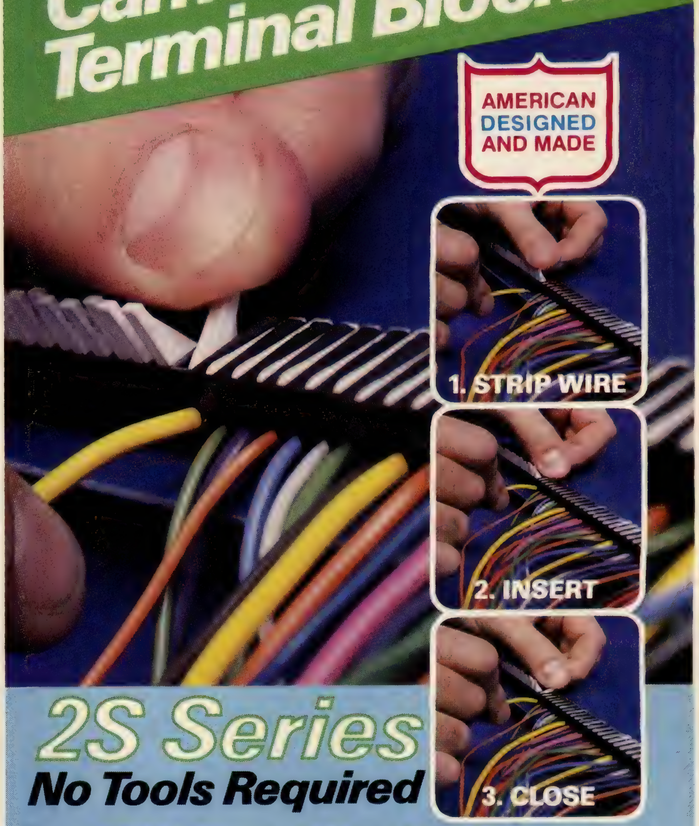
INPUTS FOR COST ESTIMATION
Estimated gate count, logic schematic, functions, package.

PRODUCTION COMMITMENTS
None.

ALTERNATE SOURCES
Fairchild; alternate sourcing effected through transfer of PG tapes.

NEW... Revolutionary Cam Actuated Terminal Blocks

AMERICAN DESIGNED AND MADE



2S Series
No Tools Required

.200" Center Spacing Fits Worldwide Standards Perfectly

- Available in 2SV solderable PC or 2SDV depluggable versions
- Both versions truly subminiature, .45" high x .52" deep
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In Illinois 1-312-682-4100

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Tel. (312) 682-4100 TWX 910-252-2118
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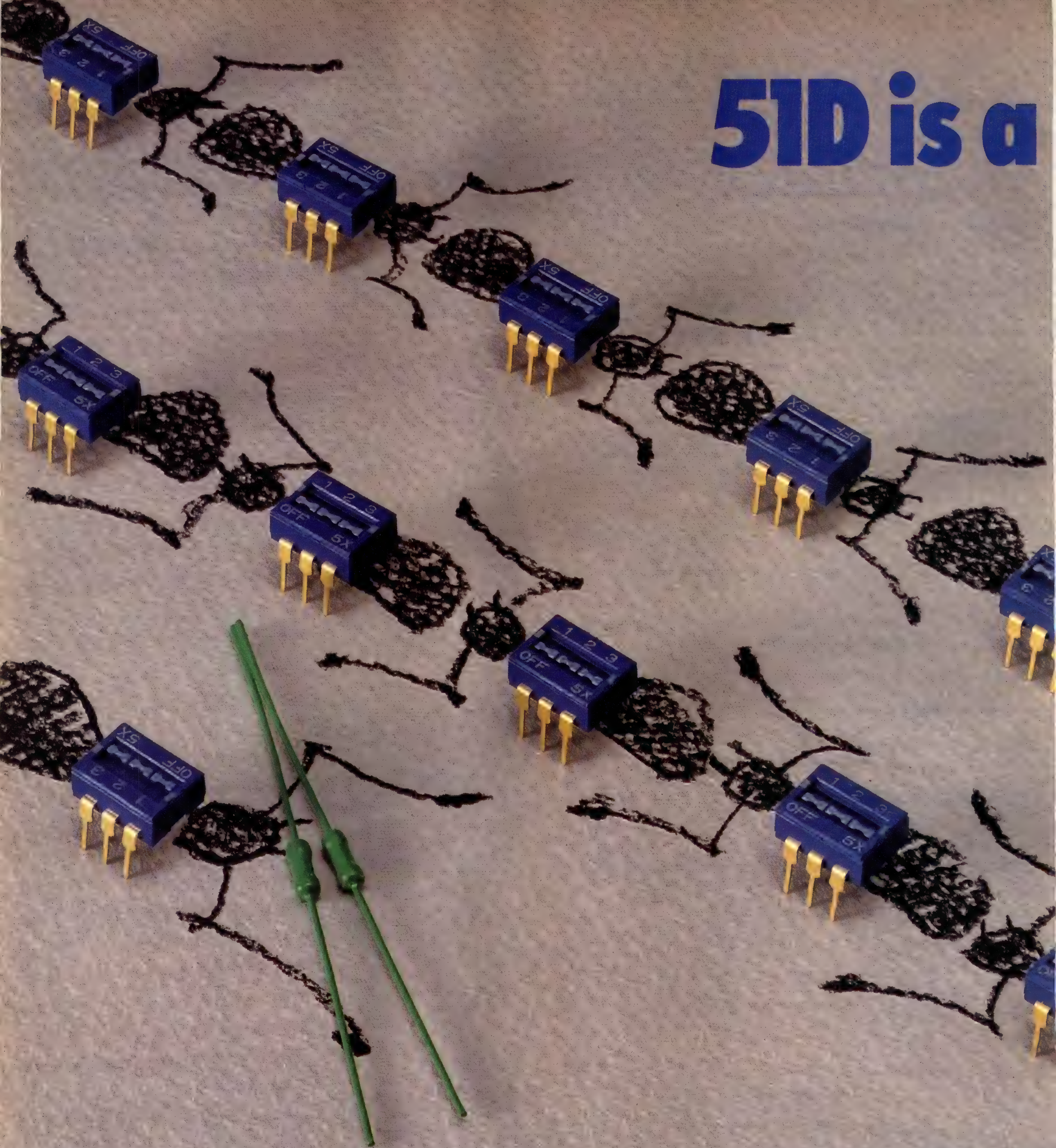
Tel. (416) 677-1500

Visit us at SOUTHCON '86, Mar. 18, 19, 20 Booths 1529, 31, 33

CIRCLE NO 99



Full line of IC sockets and PC board, circular and rectangular connectors.

tightly formed lineup.

You can
automatically pack
more JAE 51D Series dip switches
onto a PCB than —
ants into an anthill!

In Japan the name JAE is synonymous with electronic components and quality. The industry's leader. We produce nearly every type of switch. The 51D Series is the latest in low-profile dip switches and guarantees close stacking of PCBs. But the biggest news is that the switches are the same size as typical ICs. Now your dip switches can be inserted by automatic IC insertion machines. What's more, insert molded terminals and a top tape seal ensure that these switches will hold up to automatic soldering and cleaning as well. Another state-of-the-art product from JAE.

Japan Aviation Electronics Industry, Limited's manufacturing activities span the full breadth of the electronics industry. Aerospace, Connector, Electro-optics, and Commercial/Industrial Components divisions bring you the most reliable electronic products. JAE is first an aviation electronics company. Much more than just a supplier. JAE's R & D expertise produces sophisticated aviation products including inertial navigation and automatic flight control systems. Component products range from connectors and switches to relays.

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Whether you are looking for selection, reliability, innovation or prompt delivery. JAE. Call us today.

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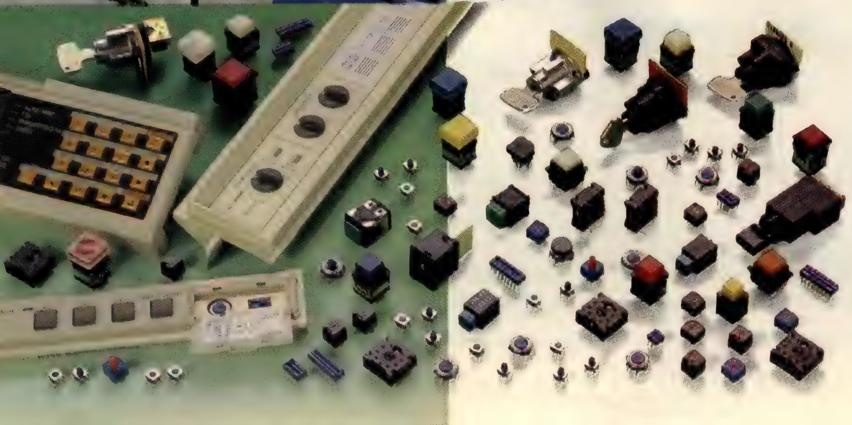
1901 E. Carnegie Ave.
Santa Ana, California 92705 USA
Tel. 714-250-8770, 1-800-JAE-PART
Telex 681438

Panel, push-button, DIP and keylock switches.



JAE

Japan Aviation Electronics Industry, Limited
21-6, 1-chome Dogenzaka
Shibuya-ku, Tokyo 150, JAPAN
Tel. 03-463-3111

CIRCLE NO 100

New from Central Data

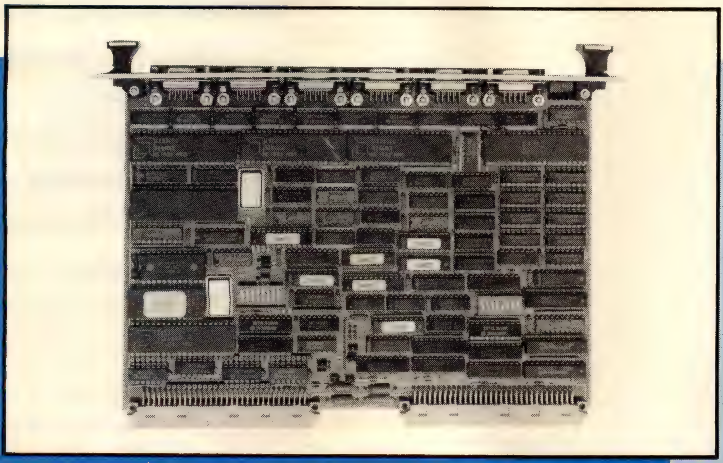
The VMEbus just got smarter

The Eight-Channel VMEbus Intelligent Terminal Controller.

There's more power, more versatility on the VMEbus with this new board from the experts in quality board design—Central Data Corporation.

Eight programmable I/O channels provide either synchronous or asynchronous RS-232 interfaces, and two can be independently configured for RS-422/449. The board's powerful 8MHz 8088 microprocessor manages all data transfers between the host and the dual-port RAM, drastically reducing host overhead. The board includes all the extra features that users and system designers need for top performance on the VMEbus:

- Full synchronous capabilities with the 8530 SCC controller chips
- 64K of parity protected dual-port RAM
- Up to 64K of EPROM and 8K of static RAM
- Automatic execution of extensive self-diagnostic routines with available firmware

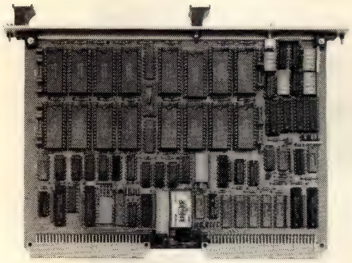


Available second quarter 1986

More system flexibility in our new memory board

The VMEbus EPROM/RAM/EEPROM Board features two independent sections for a wide range of design options on the VMEbus.

- Each section accepts eight EPROMs, RAMs or EEPROMs
- Addresses up to 1 megabyte of EPROM, 512K of RAM or 128K of EEPROM—or a combination of the three
- Responds to one or to several different address modifiers simultaneously
- 24- or 32-bit addressing and 32-bit data transfers

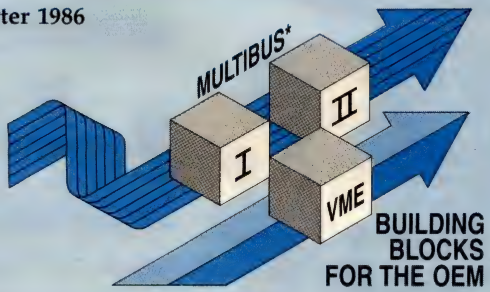


Since 1979, Central Data Corporation has been a leader in the design and manufacture of boards for the Multibus*. That experience and our commitment to quality are built into our growing line of boards for the VMEbus. Call our support engineers toll-free for information on how you can take advantage of these new designs in your VMEbus application.

TOLL FREE
800-482-0315
In Illinois 217-359-8010

Central Data

Central Data Corporation
1602 Newton Drive
Champaign, IL 61821-1098
TWX 910-245-0787


MULTIBUS*
II
I
VME
BUILDING BLOCKS FOR THE OEM

*Multibus is a trademark of Intel Corporation

VME Bus and Multibus II industrial I/O boards

You'll currently find a wide variety of VME Bus analog, digital, and specialized I/O boards for industrial-I/O systems that can fit in a Eurocard rack. In terms of direct I/O-board support, Multibus II is just beginning to emerge as a viable alternative.

Peter Harold, *European Editor*

As the directory tables on the following pages illustrate, manufacturers are offering a variety of analog, digital, and specialized I/O boards for the VME Bus. At least 23 manufacturers on both sides of the Atlantic provide more than 50 VME Bus-compatible digital I/O boards. You'll find that even more analog I/O boards are available for the VME Bus. This directory lists 88 such boards from 23 companies: Some of these boards can interface directly with low-level transducers, some can drive 4- to 20-mA current loops, and some include digital I/O channels as well as single-ended or differential analog channels. Moreover, the directory lists 26 special-purpose I/O boards for the VME Bus; these boards range from stepper-motor controllers to camera interfaces.

In general, support for the VME Bus is broad, and in addition to the I/O boards in this directory, you'll find a plethora of VME Bus CPU and memory boards, such as those in last year's Eurocard directory (EDN, April 18, 1985, pg 199), that the I/O boards can complement. When choosing VME Bus boards, though, keep in mind that the spec has gone through three revisions. If correctly designed, all the boards listed should work together, but there's no guarantee to that effect, and you may have to test your supplier's service record.

In contrast, Multibus II is not yet well established, and the Multibus II I/O-board entries appear as little more than a footnote in this directory: Only five boards are listed—three digital I/O boards, one analog I/O board, and one video data-acquisition board—and three of those aren't yet available. Intel and other independent manufacturers are concentrating on providing the core-system boards (CPU, memory, and mass-storage interfaces) that provide the hardware for software development. As Multibus II applications emerge from development systems, you can expect to see more manufacturers providing Multibus II I/O boards.

Note that employing the boards listed in this directo-

Support for the VME Bus is broad, and you'll find a plethora of VME Bus CPU and memory boards in addition to the I/O boards in this directory.

ry isn't the only way to implement I/O on the Multibus II. The Multibus II spec is actually a collection of five buses, comprising not only the parallel system bus (iPSB) but the local bus extension (iLBX II), the serial system bus (iSSB), the I/O expansion bus (iSBX), and the Multichannel I/O bus as well. Of these, the iSBX and the Multichannel I/O bus are capable of supporting data-acquisition and industrial-I/O functions. Both buses conform to the electrical and mechanical specs of Multibus I: The iSBX is a localized bus providing a means of adding piggybacked I/O modules to single-board computers and Multibus-compatible cards, and the Multichannel I/O bus supports high-speed I/O transfers to distributed peripherals over a ribbon cable. Therefore, to implement I/O on Multibus II, you could, for example, employ the piggyback iSBX boards that are available for Multibus I, or you could create a network by connecting an entire Multibus I system.

Manufacturers of VME Bus and Multibus II I/O boards

For more information on VME Bus and Multibus II I/O boards such as those listed in the directory beginning on pg 198, contact the following manufacturers directly or circle the appropriate numbers on the Information Retrieval Service card.

Acromag Inc
30765 Wixom Rd
Wixom, MI 48096
(313) 624-1541
Circle No 651

Analog Devices Inc
Two Technology Way
Norwood, MA 02062
(617) 329-4700
Circle No 652

Analogic Corp
14 Electronics Ave
Danvers, MA 01923
(617) 777-4500
Circle No 653

Anglia Technology Ltd
University Village
University of East Anglia
Norwich NR4 7TJ, UK
(0603) 503057
Circle No 654

Bicc-Vero Electronics Inc
40 Lindeman Dr
Trumbull, CT 06611
(203) 372-0038
Circle No 655

Burr-Brown Corp
International Airport Industrial Park
Box 11400
Tucson, AZ 85734
(602) 746-1111
Circle No 656

Centralp Automatismes
21 rue Marcel-Pagnol
69200 Venissieux, France
78-75-92-30
Circle No 657

Concurrent Technologies
Woodham Mortimer Pl
Rectory Lane
Woodham Mortimer
Maldon
Essex CM9 6SW, UK
(0621) 59229
Circle No 658

Compumotor Corp
1179 N McDowell Blvd
Petaluma, CA 94952
(707) 778-1244
Circle No 659

Datacube Inc
4 Dearborn Rd
Peabody, MA 01960
(617) 535-6644
Circle No 660

Data Sud Systemes SA
22 rue de Claret
Immeuble Edouard VII
BP 1067
34007 Montpellier Cedex, France
(67) 27-32-55
Circle No 661

Data Sud Systems Inc
5025 S Ash Ave
Bldg B, Suite 5
Tempe, AZ 85282
(602) 345-0940
Circle No 662

Data Translation Inc
100 Locke Dr
Marlboro, MA 01752
(617) 481-3700
Circle No 663

Datel
11 Cabot Blvd
Mansfield, MA 02048
(617) 339-9341
Circle No 664

Digital Graphic Systems Inc
2629 Terminal Blvd
Mountain View, CA 94043
(415) 962-0200
Circle No 665

Dual System Corp
2530 San Pablo Ave
Berkeley, CA 94702
(415) 549-3854
Circle No 666

DY-4 Systems Inc
888 Lady Ellen Place
Ottawa, Ontario, Canada K1Z 5M1
(613) 728-3711
Circle No 667

Efisysteme
La Boisse
01120 Montluel, France
(7) 806 2155
Circle No 668

Force Computers Inc
727 University Ave
Los Gatos, CA 95030
(408) 354-3410
Circle No 669

Force Computers GmbH
Daimlerstrasse 9
8012 Ottobrunn, West Germany
(089) 6092033
Circle No 670

Furrer-Gloor AG
Elektronische Systemtechnik
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8953 Dietikon, Switzerland
(01) 7403585
Circle No 671

General Micro Systems Inc
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(714) 625-5475
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Hamilton Standard
Digital Systems Inc
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Hillsboro, OR 97124
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Ithaca, NY 14850
(607) 277-4060
Circle No 676

Janz Computer AG
Muhlenstrasse 9
4791 Lichtenau, West Germany
(05295) 1688
Circle No 677

Finally, note that you can implement Multibus II and VME Bus I/O functions using subsystem buses. DY-4 Systems Inc, Thomson, PEP Elektronik Systeme, Motorola, and Performance Interconnect Inc offer boards that link the VME Bus to the DYBX, G64, IIOC/Eurobus, I/O Channel, and STE buses, respectively, and Furrer-Gloor AG plans to introduce in June a board that links Multibus II to the Eurolog Bus—an extension of the ECB Bus developed by Kontron Mikrocomputer GmbH. In addition, Siemens plans to introduce this year a board that links its AMS Bus with Multibus II. EDN's May 1 issue will discuss the subsystem buses and boards in more detail. **EDN**

Article Interest Quotient (Circle One)
High 473 Medium 474 Low 475

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Oskar Von Miller Str 1
8057 Eching/Munich, West Germany
(08165) 77610
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(313) 429-9027
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St Paul, MN 55107
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Motorola Inc
Microsystem Marketing MS DW212
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Tempe, AZ 85282
(602) 438-3501
Circle No 685

PEP Elektronik Systeme GmbH
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8950 Kaufbeuren, West Germany
(08341) 8974
Circle No 686

PEP Modular Computers Inc
600 N Bell Ave
Pittsburg, PA 15106
(412) 279-6661
Circle No 687

Performance Interconnect Inc
8950 Villa La Jolla Dr
Suite 2144
La Jolla, CA 92037
(619) 457-0665
Circle No 688

Philips
Industrial Data Processing Div
Box 218
5600 MD Eindhoven, The Netherlands
(040) 788286
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Plessey Microsystems Ltd
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Towcester
Northants NN12 7JN, UK
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Box 766
Marlboro, MA 01752
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Siemens AG
Zentralstelle für Information
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8000 Munich 1, West Germany
(089) 2340
Circle No 695

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Sunnyvale, CA 94086
(408) 991-2000
Circle No 696

Sky Computers Inc
Foot of John St
Lowell, MA 01852
(617) 454-6200
Circle No 697

Systemforschung
Konigstrasse 33a
5300 Bonn 1, West Germany
(0228) 223151
Circle No 698

Thomson Semiconductors
Microsystems Div
Zac Des Peupliers
23 rue des Trembles
38100 Grenoble, France
(76) 493603
Circle No 699

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Mesa, AZ 85203
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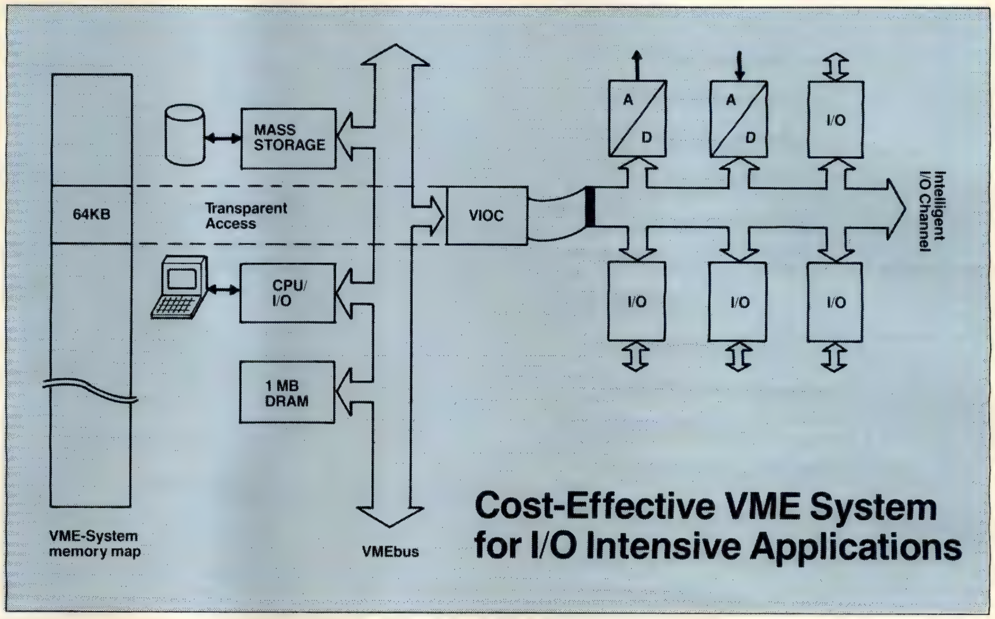
Intelligent I/O Channel for VMEbus...

PEP Modular Computers has taken a quantum technological step forward with its Intelligent I/O Channel/Eurobus. It is currently the only bus system on the market which allows use of the most common 8-bit (internal 16/32-bit) microprocessors in NMOS or high-speed CMOS, with the added flexibility of combining these traditional and future-oriented technologies.

Despite its design sophistication, the IIOC/Eurobus is extremely easy to use and offers low-cost interface requirements. With 20 address lines and 8 bi-directional data lines, the IIOC/Eurobus supports all the major low-cost microprocessors in HCMOS and NMOS—including the 68008, 8088, 68HC09, 68HC11, Z80, and others—for industrial applications with a minimum of power consumption at a maximum of reliability.

It offers standardized single-sized Eurocards (100 x 160mm) with 64-pin indirect DIN connector, and can be used in harsh environments and military applications.

The synchronous access to I/O and memory with a bandwidth of up to 3 Mbytes/s supports master and slave modules, independent of their physical position on the bus. This is possible because all addresses are fully decoded and the I/O is memory mapped. Optional asynchronous access supports especially high-end 8-bit microprocessors like the 68008 from Motorola. It is also possible to access 64-Kbyte synchronous memory-mapped I/O.



Cost-Effective VME System for I/O Intensive Applications

VME systems with low-cost I/O. PEP and other second-source suppliers offer a broad range of low-cost I/O modules for the IIOC, in most cases eliminating high development costs. Development resources can be assigned for dedicated HW- and SW- projects.

In data acquisition systems or graphic applications, it often is desirable to accomplish some data preprocessing with an 8/16-bit CPU—such as a 68008, 6809, Z80, or 18085—locally in the I/O channel before data is taken over by the master CPU on the VMEbus. The I/O operations and the preprocessing thereby are not occupying the VMEbus. This increases system throughput.

Depending on the application, the CPU on the IIOC may either run an application program in ROMs, or run under a ROM-OS, or a disk operating system such as CP/M, Flex, or OS-9, while the VME system runs under OS-9/68K, VERSAdos or another OS.

I/O channel in single height. Solutions for I/O intensive applications realized on the VMEbus only are quite expensive because of the costly I/O cards. The design of cards for the asynchronous VMEbus with its complex timing requires more time and cost than comparable I/O cards on an 8-bit synchronous I/O channel. I/O operations are usually slow and would reduce the throughput on the VMEbus. Having an I/O channel which allows direct portability with transparent access from the VMEbus eliminates those disadvantages. Because it uses modules in single height Eurocards, complete systems consisting of a VMEbus and IIOC can be built up in a common single height format.

But the IIOC from PEP is more than just an I/O channel. The architecture is based on the Eurobus and allows a local I/O processor. The heart of the PEP concept is a VMEbus-to-IIOC communications controller (VIOC). This is a single-height module which occupies one physical slot (P1) and 64 kilobytes of addressing space anywhere on the VMEbus. It is possible to have more than one VIOC installed in a VME system. Existing VME systems with double height modules may also be expanded with the VIOC. The board size and connector are standard single-height Eurocard (3.95 x 6.3 in.) and an IEC 603-2 Connector (64 pin).

The VIOC module has a flat cable of up to 50 cm in length which connects directly to the backplane of the intelligent I/O channel. The VIOC module contains all synchronization logic to allow a CPU on the VMEbus a transparent access to each memory location or peripheral register on the IIOC in a byte- or word-mode. The access time is around 2 microseconds, depending on the type of access, byte or word. If a word has to be read from the IIOC, the first byte is stored in an onboard register for the VIOC and transmitted together with the second byte as one word on the VMEbus. This concept allows the use of a broad range of low-cost I/O modules on the IIOC in a way as if they would be on the VMEbus, but eliminating the complex bus interface on each card.

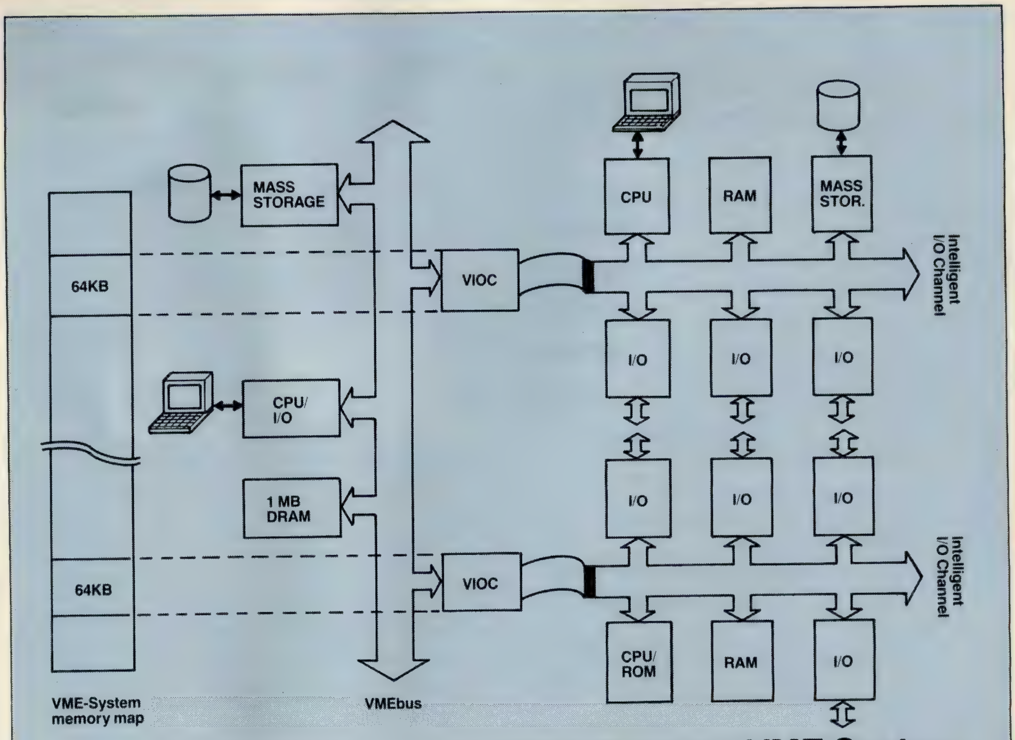
Both CPUs run simultaneously at full speed only if the CPU on the VMEbus wants to access the IIOC, the VIOC module automatically requests a DMA on the IIOC for each transfer. If there is another DMA controller on the IIOC (i.e., a floppy disk controller) it has higher priority than the VIOC. It is important to know that the master CPU on the VMEbus has access to the IIOC; however, the slave CPU on the I/O channel has no access to the VMEbus. Communications between the CPUs can be implemented by using interrupts or flags indicating a ready condition. Messages and data can be exchanged via a common memory area on the IIOC which is used as a mailbox without the need of dual-ported RAM. Powerful multi- and coprocessor systems are possible without the need of complex communications software.

VME system with more than one IIOC. As mentioned above, it is also possible to have more than one IIOC connected to a VMEbus. There is only a physical limitation due to the maximum length of the flat cable between the VIOC module on the VMEbus and the IIOC backpanel. It is also possible to run different operating systems on different I/O channels.

...supports NMOS and HCMOS microprocessors

Communications between the various I/O channels works then through the master CPU on the VMEbus. Power supply produces +5V and +12V, with +5V standby.

The PEP concept is a cost-effective way of implementing complete VMEbus systems including an I/O channel for applications which require lots of I/O or powerful multi- and co-processing capabilities, all in a compact single Eurocard. Supported by a worldwide network of vendors, which guarantees service and product availability, the Intelligent I/O channel/Eurobus is the standard bus architecture for future oriented industrial designs with a direct link to the industry standard bus for 16/32 bit, the VMEbus.



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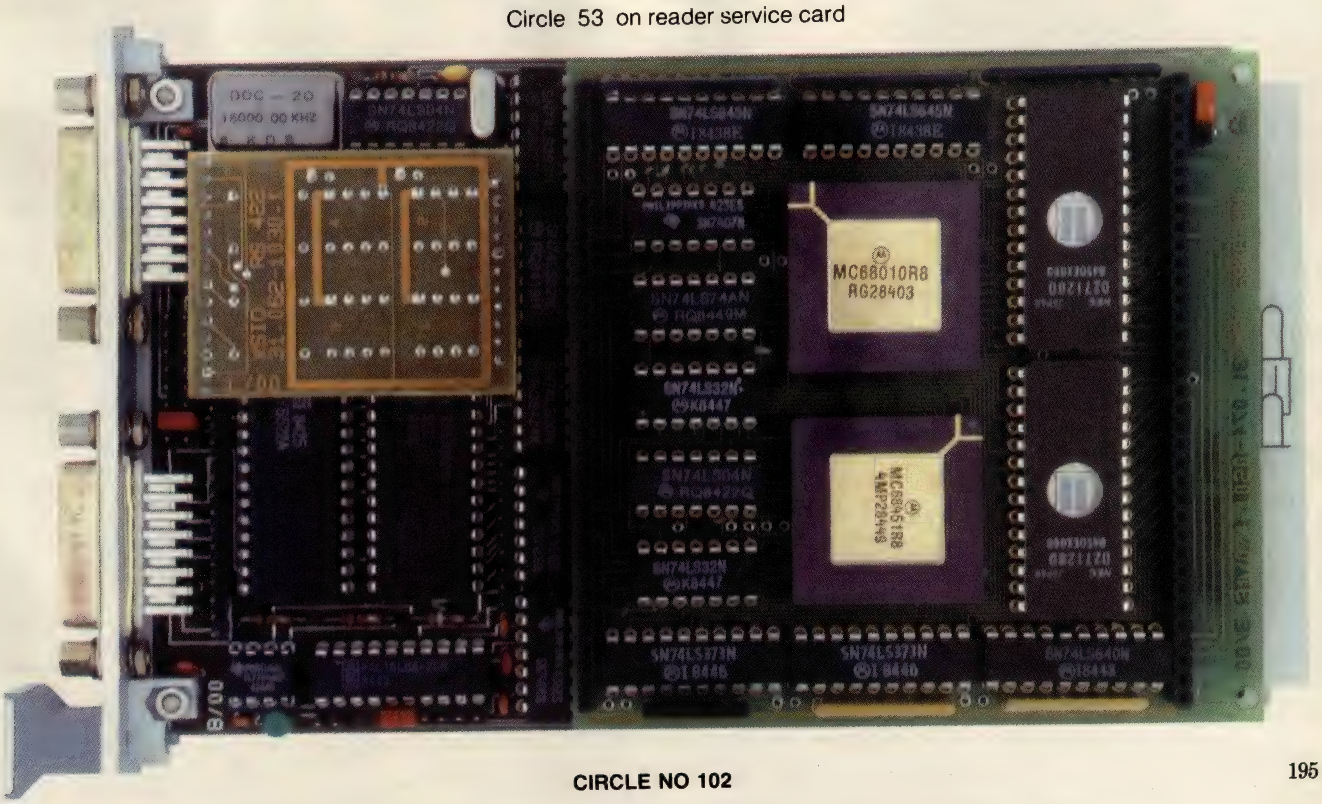

CIRCLE NO 102

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CIRCLE NO 103

VME BUS ANALOG I/O BOARDS

			ANALOG INPUTS				
MANUFACTURER	MODEL NUMBER	EUROCARD SIZE	CHANNELS (SE/DIF)	BEST RESOLUTION (BITS)	BEST ACCURACY (% FSR)	INPUT RANGES (V)	RANGING
ACROMAG	AVME9100	D	SEE COMMENTS	14	—	±10	
	AVME9110	D	32/16	14	—	±10	
ANALOG DEVICES	RTI-600	S	16/8, 32/16 (OPT)	12	0.01	10, ±10, RPGA (x1 TO x1000)	LP
	RTI-602	S					
ANALOGIC	IB3100	D	8 DIF	14	0.024	±0.0125, ±0.025, ±0.05, ±0.1, ±1.25, ±2.5, ±5, ±10	—
	ITG1300	—	8 DIF	15	—	10V, TC, 4 TO 20 mA	—
	ITG1303	—	16 DIF	12	—	—	—
	ITG1340	—					
ANGLIA TECHNOLOGY	AD12VME-16	D	16/8	12	0.025	0.1, 1, 5, 10, ±0.1, ±1, ±5, ±10	SP
	AD12VME-32	D	32/16	12	0.025	0.1, 1, 5, 10, ±0.1, ±1, ±5, ±10	SP
BICC-VERO	VME48240	S					
	VME48250	S	16/8	12	—	10, 20, ±5, ±10, RPGA (x1 TO x1000)	LP
	VME48251	S	32/16	12	—	10, 20, ±5, ±10, RPGA (x1 TO x1000)	LP
BURR-BROWN	MPV950D	D	8 SE AND 8 SE/DIF	12	0.05	10, ±5, ±10, RPGA (x1 TO x10) ON 8 SE/DIF CHANNELS	LP
	MPV950S	D	16 SE	12	0.05	10, ±5, ±10	LP
	MPV960	D	4	12	0.05	5, 10, ±2.5, ±5, ±10	—
	MPV901	D	32/16	12	0.05	5, 10, ±2.5, ±5, ±10, RPGA (x1 TO x1000)	LP
	MPV901A	D	32/16	12	0.05	5, 10, ±2.5, ±5, ±10, RPGA (x1 TO x1000)	LP
	MPV901P	D	32/16	12	0.05	5, 10, ±2.5, ±5, ±10, SPGA (x1, x10, x100, x1000)	LP/SP
	MPV904	D					
	MPV905	D	16/8	12	—	5, 10, ±5, ±10, 0 TO 20 mA, 4 TO 20 mA	LP

KEY:

—	INFORMATION NOT PROVIDED
D	DOUBLE-HEIGHT
DIF	DIFFERENTIAL
DMA	DIRECT MEMORY ACCESS
LP	LINK PROGRAMMABLE
LSB	LEAST SIGNIFICANT BIT
OPT	OPTIONAL
RPGA	RESISTOR-PROGRAMMABLE GAIN AMPLIFIER
RTD	PLATINUM RESISTANCE THERMOMETER
S	SINGLE-HEIGHT
SE	SINGLE-ENDED
SG	STRAIN GAUGE
SP	SOFTWARE PROGRAMMABLE
SPGA	SOFTWARE-PROGRAMMABLE GAIN AMPLIFIER
TC	THERMOCOUPLE
TYP	TYPICAL

A BLANK ENTRY INDICATES THAT THE FUNCTION IS NOT OFFERED.

		ANALOG OUTPUTS						
CONVERSION TIME* (μSEC)**	MAXIMUM THROUGHPUT* (kHz)	CHANNELS	RESOLUTION (BITS)	BEST ACCURACY (% FSR)	OUTPUT RANGES (V)**	SETTLING TIME (μSEC)**	PRICE	COMMENTS
—	—						—	INTELLIGENT SUB-SYSTEM; 256-CHANNEL EXPANSION
—	—						—	
25	—						—	
		4	12	0.03	5, 10, ±5, ±10, 4 TO 20 mA (OPT)	25	—	
10 mSEC TO 60 mSEC	—						—	INTELLIGENT TC SUB-SYSTEM; 120-CHANNEL EXPANSION; 1-kV A/D ISOLATION
10 mSEC TO 60 mSEC	—						—	INTELLIGENT SUB-SYSTEM; 120-CHANNEL EXPANSION; A/D ISOLATION
—	—						—	
		2 OR 4	—	—	4 TO 20 mA	—	—	EXPANDER CARD FOR ITG1300; 1-kV D/A ISOLATION; DIGITAL I/O
35	—						£1395	SOFTWARE-CONFIGURED INPUTS; 10V REF OUTPUT; 500V A/D ISOLATION
35	—						£1520	SOFTWARE-CONFIGURED INPUTS; 10V REF OUTPUT; 500V A/D ISOLATION
		4	12		5, 10, ±2.5, ±5, ±10	4	—	
35	—						—	
35	—						—	
3 MAX	—						—	
3 MAX	—						—	
11	—						—	4-CHANNEL SIMULTANEOUS SAMPLING; TMS320 DSP; A/D ISOLATION
70	—						—	
70	—	2	12	0.05	5, 10, ±2.5, ±5, ±10	5	—	
70	—	2	12	0.05	5, 10, ±2.5, ±5, ±10	5	—	
		16	12	0.075	5, 10, ±2.5, ±5, ±10	3.5 mSEC TO 0.1% FSR	—	
		8	12	0.05	0 TO 20 mA, 4 TO 20 mA, 5 TO 25 mA	3.5 mSEC TO 0.1% FSR	—	A/D ISOLATION

*CONVERSION TIME AND THROUGHPUT FIGURES MAY NOT INCLUDE CHANNEL ACQUISITION, AMPLIFIER SETTLING, OR SAMPLE/HOLD SETTLING TIMES. THESE FIGURES SHOULD THEREFORE ONLY BE USED AS A GUIDE WHEN COMPARING DIFFERENT BOARDS. IN ADDITION, THE FIGURES MAY BE WORSE FOR SOME INPUT RANGES.

**UNLESS OTHERWISE SPECIFIED

Table continued on pg 200

VME BUS ANALOG I/O BOARDS *(Continued)*

			ANALOG INPUTS				
MANUFACTURER	**MODEL NUMBER**	**EUROCARD SIZE**	**CHANNELS** (SE/DIF)	**BEST RESOLUTION** (BITS)	**BEST ACCURACY** (% FSR)	**INPUT RANGES** (V)	**RANGING**
DATA SUD SYSTEMS	DSSE16AD12-1	D	16/8	12	—	5, 10, ±5, ±10, 0 TO 20 mA, 4 TO 20 mA, SPGA (x1 TO x1024)	LP/SP
	DSSE16AD12-2	D					
	DSSE8DA12	D	32/16	12	0.03	10, ±10, SPGA (x1, x2, x4, x8)	LP/SP
DATA TRANSLATION	DT1402-F	D	16 SE	12 + SIGN	0.035	±5	
	DT1414	S	32/16	12	0.03	10, ±10, SPGA (x1, x2, x4, x8)	LP/SP
	DT1401	D	16 DIF	16	0.0075	±10, SPGA (x1, x2, x4, x8)	SP
	DT1401/5716	D	32/16	12	0.01	10, ±10, SPGA (x1, x10, x100, x500)	LP/SP
	DT1405	D	16 DIF	16	0.0075	±10, SPGA (x1, x10, x100, x500)	SP
	DT1405/5716	D	4 SE	12	0.04	10, ±10	LP
	DT1408	D					
	DT1403-2	D					
	DT1403-4	D					
	DT1406-8V	D					
	DT1406-8M	D					
	DT1406-8CL	D	4	—	—	TC, RTD, AND HI-LEVEL/4- TO 20-mA VERSIONS	—
DATEL	DVME602	D	32/16	12	—	—	—
	DVME611-A, -B	D	32/16	14	—	—	—
	DVME611-C	D	32/16	16	—	—	—
	DVME611-D	D	32/16	12	—	—	—
	DVME612-A, -B	D	32/16	14	—	—	—
	DVME612-C	D	32/16	16	—	—	—
	DVME612-D	D					
	DVME624-V1, -V2	D					
	DVME624-C1, -C2	D					
	DVME628-V	D					
	DVME628-C	D					

KEY:

—	INFORMATION NOT PROVIDED
D	DOUBLE-HEIGHT
DIF	DIFFERENTIAL
DMA	DIRECT MEMORY ACCESS
LP	LINK PROGRAMMABLE
LSB	LEAST SIGNIFICANT BIT
OPT	OPTIONAL
RPGA	RESISTOR-PROGRAMMABLE GAIN AMPLIFIER
RTD	PLATINUM RESISTANCE THERMOMETER
S	SINGLE-HEIGHT
SE	SINGLE-ENDED
SG	STRAIN GAUGE
SP	SOFTWARE PROGRAMMABLE
SPGA	SOFTWARE-PROGRAMMABLE GAIN AMPLIFIER
TC	THERMOCOUPLE
TYP	TYPICAL

A BLANK ENTRY INDICATES THAT THE FUNCTION IS NOT OFFERED.

		ANALOG OUTPUTS						
CONVERSION TIME* (μSEC)**	MAXIMUM THROUGHPUT* (kHz)	CHANNELS	RESOLUTION (BITS)	BEST ACCURACY (% FSR)	OUTPUT RANGES (V)**	SETTLING TIME (μSEC)**	PRICE	COMMENTS
25 (TYP)	—						—	A/D ISOLATION
25 (TYP)	—						—	
		8	12	—	5, 10, ±5, ±10, 0 TO 20 mA, 4 TO 20 mA	3	—	16-LINE DIGITAL I/O; PACER CLOCK (1.66-μSEC TO 200-SEC INTERVAL)
4	125						$1945	
200	—						$395	16-LINE DIGITAL I/O; PACER CLOCK (1.66-μSEC TO 200-SEC INTERVAL)
10	50	2	12	0.025	5, 10, ±5, ±10	20 MAX	$1595	16-LINE DIGITAL I/O; PACER CLOCK (1.66-μSEC TO 200-SEC INTERVAL)
50	2.5	2	12	0.025	5, 10, ±5, ±10	20 MAX	—	16-LINE DIGITAL I/O; PACER CLOCK (1.66-μSEC TO 200-SEC INTERVAL)
10	50	2	12	0.025	5, 10, ±5, ±10	20 MAX	$1695	16-LINE DIGITAL I/O; PACER CLOCK (1.66-μSEC TO 200-SEC INTERVAL)
50	2.5	2	12	0.025	5, 10, ±5, ±10	20 MAX	—	16-LINE DIGITAL I/O; PACER CLOCK (1.66-μSEC TO 200-SEC INTERVAL)
4	100	2	12	0.025	5, 10, ±5, ±10	20 MAX	$2095	DEGLITCHED OUTPUTS
		2	16	0.003	±10	10	—	DEGLITCHED OUTPUTS
		4	16	0.003	±10	10	—	EXTERNAL REFERENCE-VOLTAGE INPUT
		8	12	0.025	10, ±10	8	$1495	
		8	12	0.025	4 TO 20 mA	35	$1495	
		8	12	0.025	4- TO 20-mA CURRENT LOOP	35	—	
—	—						—	
20 (-A), 4 (-B)	—						—	
45	—						—	
400	—						—	
20 (-A), 4 (-B)	—	2	—	—	—	—	—	
45	—	2	—	—	—	—	—	
400	—	2	—	—	—	—	—	D/A ISOLATION
		4	—	—	VOLTAGE	30 (-V1), 6 (-V2)	—	D/A ISOLATION
		4	—	—	CURRENT	30 (-V1), 6 (-V2)	—	
		8	—	—	VOLTAGE	6	—	
		8	—	—	CURRENT LOOP	6	—	

*CONVERSION TIME AND THROUGHPUT FIGURES MAY NOT INCLUDE CHANNEL ACQUISITION, AMPLIFIER SETTLING, OR SAMPLE/HOLD SETTLING TIMES. THESE FIGURES SHOULD THEREFORE ONLY BE USED AS A GUIDE WHEN COMPARING DIFFERENT BOARDS. IN ADDITION, THE FIGURES MAY BE WORSE FOR SOME INPUT RANGES.

**UNLESS OTHERWISE SPECIFIED

Table continued on pg 202

VME BUS ANALOG I/O BOARDS *(Continued)*

			ANALOG INPUTS				
MANUFACTURER	**MODEL NUMBER**	**EUROCARD SIZE**	**CHANNELS** (SE/DIF)	**BEST RESOLUTION** (BITS)	**BEST ACCURACY** (% FSR)	**INPUT RANGES** (V)	**RANGING**
FORCE COMPUTERS	SYS68K/ADDA-1R	D	32/16	12	0.05	5, 10, ±2.5, ±5, ±10, RPGA (x1 TO x1000)	LP
	SYS68K/ADDA-1S	D	32/16	12	0.05	5, 10, ±2.5, ±5, ±10, SPGA (x1, x10, x100, x1000)	LP/SP
GENERAL MICRO SYSTEMS	GMSV02	D	48/24	12	—	BIPOLAR, x1, x4, x10, SPGA (x1, x2, x5, x10)	LP/SP
	GMSV03	D	6 DIF	16 + SIGN	—	PGA ON EACH INPUT	—
IRONICS	IV-1641	D	16/8	12	—	10, ±5, ±10	SP
	IV-1645D	D	8 SE AND 8 SE/DIF	12	0.05	10, ±5, ±10, RPGA (x1 TO x10) ON 8 SE/DIF CHANNELS	LP
	IV-1645S	D	16 SE	12	0.05	10, ±5, ±10	LP
	IV-1646	D	4	12	0.05	5, 10, ±2.5, ±5, ±10	—
	IV-1642	D	32/16	12	0.05	5, 10, ±2.5, ±5, ±10, RPGA (x1 TO x1000)	LP
	IV-1642A	D	32/16	12	0.05	5, 10, ±2.5, ±5, ±10, RPGA (x1 TO x1000)	LP
	IV-1642P	D	32/16	12	0.05	5, 10, ±2.5, ±5, ±10, SPGA (x1, x10, x100, x1000)	LP/SP
	IV-1643	D					
	IV-1644	D					
JANZ COMPUTER	VAN-8	D	8 SE	12	—	±0.1, ±0.5, ±1, ±10, 0 TO 10 VARIABLE	—
K2 ELECTRONIC DESIGN	ADC1012	D	32/16	12	—	10 mV TO 10V	—
	ADC1008	D	16/8	8	—	5, 10, ±5	—
MIZAR	VME8605	S	32 OR 16	12	—	x1, x10, x100, x1000, RPGA (x1 TO x1000)	LP
	VME8610	S					
PEP MODULAR COMPUTERS	VADI-1	S	1 DIF	16	0.006	±5, ±10	—
PHILIPS/SIGNETICS	PG3650	D	32/16	12	0.05	5, 10, ±2.5, ±5, ±10, RPGA (x1 TO x1000)	LP
	PG3651	D	32/16	12	0.05	5, 10, ±2.5, ±5, ±10, RPGA (x1 TO x1000)	LP
	PG3652	D	32/16	12	0.05	5, 10, ±2.5, ±5, ±10, SPGA (x1, x10, x100, x1000)	LP/SP

KEY:

—	INFORMATION NOT PROVIDED
D	DOUBLE-HEIGHT
DIF	DIFFERENTIAL
DMA	DIRECT MEMORY ACCESS
LP	LINK PROGRAMMABLE
LSB	LEAST SIGNIFICANT BIT
OPT	OPTIONAL
RPGA	RESISTOR-PROGRAMMABLE GAIN AMPLIFIER
RTD	PLATINUM RESISTANCE THERMOMETER
S	SINGLE-HEIGHT
SE	SINGLE-ENDED
SG	STRAIN GAUGE
SP	SOFTWARE PROGRAMMABLE
SPGA	SOFTWARE-PROGRAMMABLE GAIN AMPLIFIER
TC	THERMOCOUPLE
TYP	TYPICAL

A BLANK ENTRY INDICATES THAT THE FUNCTION IS NOT OFFERED.

		ANALOG OUTPUTS						
CONVERSION TIME* (μSEC)**	MAXIMUM THROUGHPUT* (kHz)	CHANNELS	RESOLUTION (BITS)	BEST ACCURACY (% FSR)	OUTPUT RANGES (V)**	SETTLING TIME (μSEC)**	PRICE	COMMENTS
100	10	2	12	0.15	5, 10, ±2.5, ±5, ±10	5	$1850	
100	10	2	12	0.15	5, 10, ±2.5, ±5, ±10	5	$2180	
—	50	2	12		VOLTAGE, 4 TO 20 mA	—	$2995	INTELLIGENT SUBSYSTEM; SUBSET FUNCTIONS FROM $2795
—	—						—	INTELLIGENT SUBSYSTEM; SG EXCITATION; 12-BIT VERSION AVAILABLE
—	25 (TYP)						—	REQUIRES AN EXTERNAL ±18V SUPPLY
3 MAX	330						—	
3 MAX	330						—	
—	88						—	4-CHANNEL SIMULTANEOUS SAMPLING; TMS320 DSP; A/D ISOLATION
70	—						—	
70	—	2	12	0.05	5, 10, ±2.5, ±5, ±10	5	—	
70	—	2	12	0.05	5, 10, ±2.5, ±5, ±10	5	—	ONBOARD RAM FOR SEPARATE CHANNEL GAINS
		16	12	0.075	5, 10, ±2.5, ±5, ±10	3.5 mSEC TO 0.1% FSR	—	
		8	12	0.05	0 TO 20 mA, 4 TO 20 mA, 5 TO 25 mA	3.5 mSEC TO 0.1% FSR	—	
3	—						—	DMA ON P2 CONNECTOR; THRESHOLD DETECTION; 2.5-kV A/D ISOLATION
—	—						—	
—	—	4	8	—	5, 10, ±5, ±10	—	—	
—	25						—	
		4	12	—	—	3	—	
2	500						—	A/D ISOLATION
100	10						$1745	
100	10	2	12	0.15	5, 10, ±2.5, ±5, ±10	5	$1995	
100	10	2	12	0.15	5, 10, ±2.5, ±5, ±10	5	$2355	

*CONVERSION TIME AND THROUGHPUT FIGURES MAY NOT INCLUDE CHANNEL ACQUISITION, AMPLIFIER SETTLING, OR SAMPLE/HOLD SETTLING TIMES. THESE FIGURES SHOULD THEREFORE ONLY BE USED AS A GUIDE WHEN COMPARING DIFFERENT BOARDS. IN ADDITION, THE FIGURES MAY BE WORSE FOR SOME INPUT RANGES.

**UNLESS OTHERWISE SPECIFIED

Table continued on pg 204

VME BUS ANALOG I/O BOARDS *(Continued)*

			ANALOG INPUTS				
MANUFACTURER	MODEL NUMBER	EUROCARD SIZE	CHANNELS (SE DIF)	BEST RESOLUTION (BITS)	BEST ACCURACY (% FSR)	INPUT RANGES (V)	RANGING
SCIENCE APPLICATIONS INTERNATIONAL	SAIVME-3100	D	16 SE	12	0.025 (TYP)	5, 10, ±2.5, ±5, ±10	LP
	SAIVME-3110	D	1 DIF	12	0.025 (TYP)	10, ±5, ±10, SPGA (x1, x10, x100)	LP/SP
	SAIVME-4100	D					
	SAIVME-4105	D					
	SAIVME-4500	D					
SERIAL LAB PRODUCTS	SL-1000	D	16/8	12	—	—	—
SYSTEM FORSCHUNG	AD16D21		16 DIF	12	—	±5, ±10	—
	AD16D24		16 DIF	12	—	±5, ±10	—
	AD32S6		32 SE	12	—	5, 10	—
	AD32S9		32 SE	12	—	5, 10	—
	DA-4						
THOMSON SEMICONDUCTORS	TSVME401	D					
	TSVME402	D	16/8	12	0.025	±5, ±10	LP
	TSVME403	D	16/8	12	0.025	±5, ±10	LP
URTEC	3UP2-AD1	S	6	4½ DIGIT	—	—	—
	3UD1	S					
XYCOM	XVME-560	D	64	12	—	x1, x2, x4, x8	—
	XVME-540	D	32/16	12	—	BIPOLAR, x1, x2, x5, x10	—
	XVME-530	D					

KEY:

—	INFORMATION NOT PROVIDED	OPT	OPTIONAL	SP	SOFTWARE PROGRAMMABLE
D	DOUBLE-HEIGHT	RPGA	RESISTOR-PROGRAMMABLE GAIN AMPLIFIER	SPGA	SOFTWARE-PROGRAMMABLE GAIN AMPLIFIER
DIF	DIFFERENTIAL	RTD	PLATINUM RESISTANCE THERMOMETER	TC	THERMOCOUPLE
DMA	DIRECT MEMORY ACCESS	S	SINGLE-HEIGHT	TYP	TYPICAL
LP	LINK PROGRAMMABLE	SE	SINGLE-ENDED		
LSB	LEAST SIGNIFICANT BIT	SG	STRAIN GAUGE		

A BLANK ENTRY INDICATES THAT THE FUNCTION IS NOT OFFERED.

MULTIBUS II ANALOG I/O BOARDS

			ANALOG INPUTS				
MANUFACTURER	MODEL NUMBER	EUROCARD SIZE	CHANNELS (SE/DIF)	BEST RESOLUTION (BITS)	BEST ACCURACY (% FSR)	INPUT RANGES (V)	RANGING
EFISYSTEME	CESA-2/01	D+	64/32	12	—	INCLUDING 5, 10, ±5, ±10	—

*CONVERSION TIME AND THROUGHPUT FIGURES MAY NOT INCLUDE CHANNEL ACQUISITION, AMPLIFIER SETTLING, OR SAMPLE/HOLD SETTLING TIMES. THESE FIGURES SHOULD THEREFORE ONLY BE USED AS A GUIDE WHEN COMPARING DIFFERENT BOARDS. IN ADDITION, THE FIGURES MAY BE WORSE FOR SOME INPUT RANGES.

		ANALOG OUTPUTS						
CONVERSION TIME* (μSEC)**	MAXIMUM THROUGHPUT* (kHz)	CHANNELS	RESOLUTION (BITS)	BEST ACCURACY (% FSR)	OUTPUT RANGES (V)**	SETTLING TIME (μSEC)**	PRICE	COMMENTS
20	—						$1795	BUILT-IN TEST; TEST VOLTAGE OUTPUT
15 (7 OPT)	64 (120 OPT)						$1295	OPTIONAL ±10.24V RANGE AND x1, x8, x64 SPGA
		16	12	0.075 (TYP)	10 (OPT), ±10	8 TO ½ LSB	$2295	BUILT-IN TEST; 10V REFERENCE OUTPUT; SUBSET FUNCTIONS FROM $995
		8	12	—	−10, ±10	6 TO ½ LSB	$1595	MULTIPLYING D/A CONVERTER; BUILT-IN TEST
		16	12	0.1	5, 10, ±2.5, ±5, ±10	1.3 mSEC TO 0.01%	$1395	16-CHANNEL SINGLE-ENDED INPUT MULTIPLEXER; BUILT-IN TEST
20	—	2	12	—	—	—	$2195	INTELLIGENT SUBSYSTEM; DIGITAL/SERIAL I/O AND COUNTER/TIMER FUNCTIONS
21	—						DM 3400	
24	—						DM 2450	
6	—						DM 3100	ALL BOARDS REQUIRE AN MPVME-1500 OR MPVME-1700 CARD
9	—						DM 2450	
		4	12	—	5, 10, ±2.5, ±5, ±10	2	DM 1465	
		1	12	—	±10	—	—	32-CHANNEL RELAY BOARD WITH OPTIONAL 12-BIT D/A CONVERTER
32	—						—	
32	—	8	12	0.025	±5, ±10	4	—	
—	—						—	
		12	10	—	2.5	—	—	
—	—						—	
—	—	4	12	—	BIPOLAR VOLTAGE, 4 TO 20 mA	—	—	
		8	12	—	VOLTAGE, CURRENT	—	—	OPTICAL D/A ISOLATION

*CONVERSION TIME AND THROUGHPUT FIGURES MAY NOT INCLUDE CHANNEL ACQUISITION, AMPLIFIER SETTLING, OR SAMPLE/HOLD SETTLING TIMES. THESE FIGURES SHOULD THEREFORE ONLY BE USED AS A GUIDE WHEN COMPARING DIFFERENT BOARDS. IN ADDITION, THE FIGURES MAY BE WORSE FOR SOME INPUT RANGES.

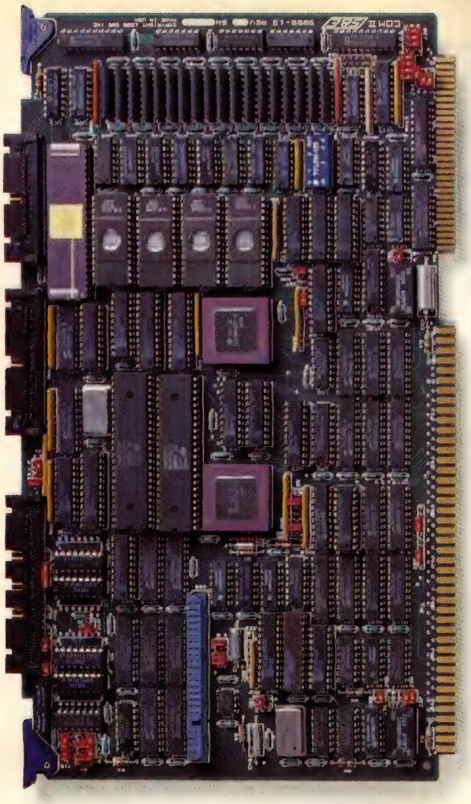
**UNLESS OTHERWISE SPECIFIED

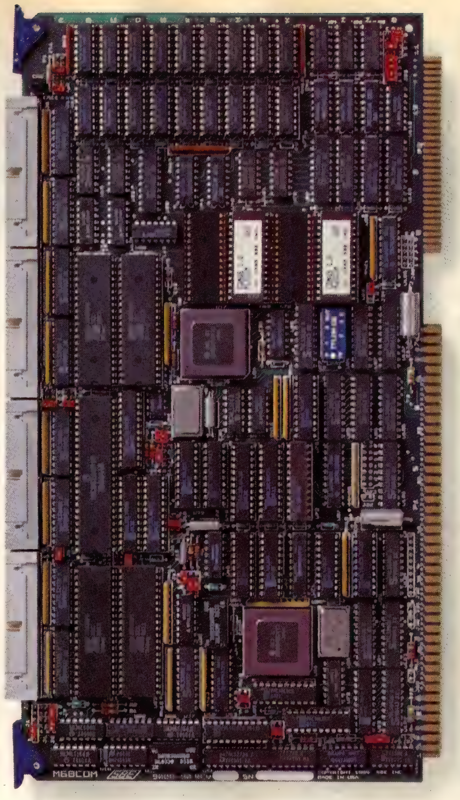
		ANALOG OUTPUTS						
CONVERSION TIME* (μSEC)	MAXIMUM THROUGHPUT* (kHz)	CHANNELS	RESOLUTION (BITS)	BEST ACCURACY (% FSR)	OUTPUT RANGES (V)	SETTLING TIME (μSEC)	PRICE	COMMENTS
40	25	4	12	—	5, 10, ±5, ±10, 4 TO 20 mA	—	(AVAIL Q3 '86)	BUILT-IN SELF TEST; 16k-BYTE DATA BUFFER; 32-BIT iPSB INTERFACE

KEY:

—	INFORMATION NOT PROVIDED	DIF	DIFFERENTIAL
D+	DOUBLE EXTENDED EUROCARD	SE	SINGLE-ENDED

Tables continued on pg 208


COM-2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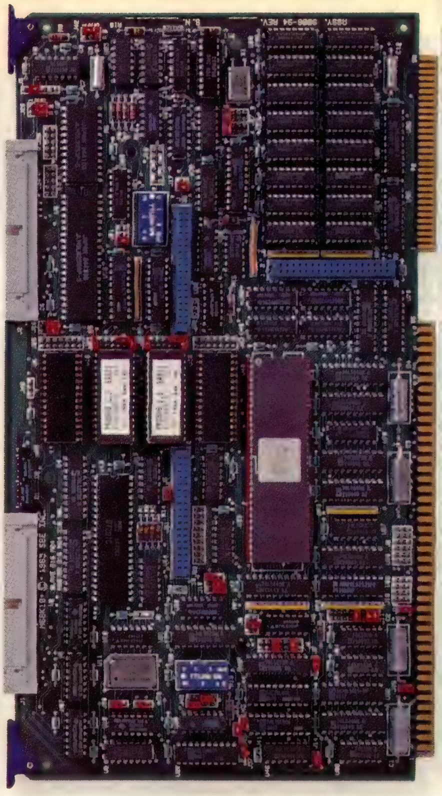
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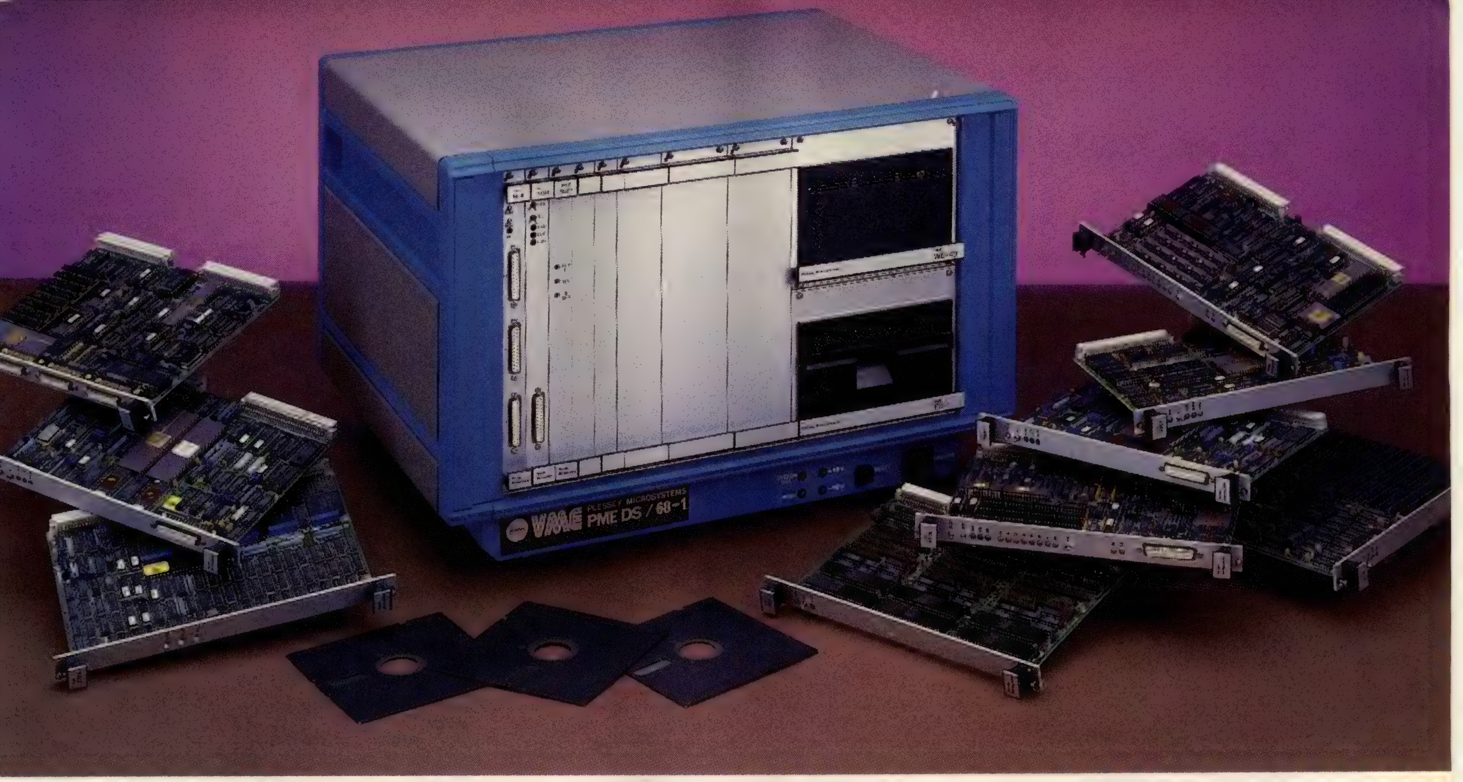

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England
Water Lane
Towcester
Northants
NN12 7JN
(0327) 50312

France
BP 74
7-9 rue Denis Papin
78194 Trappes Cedex
(3) 0514952

Germany
Bahnhofstraβe 38
D-6090 Russelsheim
(0 61 42) 6 80 04

United States
One Blue Hill Plaza
Pearl River
NY 10965
(914) 735-4661

For additional information, clip and mail to Plessey Microsystems Ltd., Water Lane, Towcester, Northants, UK NN12 7JN

Name

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Title

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VME BUS DIGITAL I/O BOARDS

			NUMBER OF LINES				INPUT	OUTPUT
MANUFACTURER	MODEL NUMBER	EUROCARD SIZE	INPUT	OUTPUT	INPUT/ OUTPUT	HAND-SHAKE	DC VOLTAGE*	DC VOLTAGE*
ACROMAG	AVME-9480	D			64	8	30V	30V
BICC-VERO	VME-48210	S			32	8	TTL	TTL
DATA SUD SYSTEMS	DSSE16IN	D	16				—	
	DSSE32IN	D	32				—	
	DSSE16RS	D		16				250V DC, AC
	DSSE32RS	D		32				250V DC, AC
DATA TRANSLATION	DT1417	S			32		TTL	TTL
DATEL	DVME-660	—			48		—	—
FORCE COMPUTERS	SYS68K/OPIO-1	D	32	32		16	TTL	TTL
	SYS68K/PIO-1	D	32	32		16	TTL	TTL
GENERAL MICRO SYSTEMS	GMSV04	D			148		TTL	TTL
HAMILTON STANDARD	MK75912	SEE COMMENTS			16	4	TTL	TTL
IRONICS	IV1623	D			48		30V	30V
JANZ COMPUTER	VPIO-80	D			32		70V	70V
					48		TTL	TTL
KONTRON	KVME68305	S			32			—
LOGICAL DESIGN GROUP	VME-2232D	D	32	32			5 TO 12V (24 OPT)	—
	VME-9100D	D			60	12	TTL	TTL
MATRIX	MS-PIM	S			32	8	TTL	TTL
				4	1		—	—
MICRODIMENSIONS	MICRO-VME-200	D			32	8	TTL	TTL
	MICRO-VME-210	D			16		—	—
	MICRO-VME-220	D	16	16			24V	26V
	MICRO-VME-230	D			16	4	TTL	TTL
MIZAR	VME8305	S			32			—
MOTOROLA	MVME-340	D			56	8	IEEE-488	IEEE-488
PEP MODULAR COMPUTER	VSIO	S			20		TTL	TTL
PHILIPS/SIGNETICS	PG3600	D	16	16		4	TTL	TTL
	PG8710	S	16			4	5V, 12V	
	PG8711	S	16				±50V	
	PG8720	S		16		5		30V
	PG8721	S		16				30V
SCIENCE APPLICATIONS INTERNATIONAL	SAIVME-1000	D	16				5 TO 240V AC, DC	
	SAIVME-1001	D	16				5 TO 240V AC, DC	
	SAIVME-1101	D	32				TTL	
	SAIVME-1110	D	64				5 TO 50V	
	SAIVME-1130	D	64				TTL	
	SAIVME-1150	D	64				5 TO 48V	
	SAIVME-1160	D	32				5 TO 48V	

* UNLESS OTHERWISE SPECIFIED

KEY:

—	INFORMATION NOT PROVIDED
D	DOUBLE-HEIGHT
IEEE-488	IEEE-488-COMPATIBLE DRIVER/RECEIVER
OC	OPEN-COLLECTOR OUTPUT
OPT	OPTIONAL
OPTO	OPTICALLY COUPLED
PR	PULLUP RESISTOR
S	SINGLE-HEIGHT
TTL	TTL-COMPATIBLE INPUT OR OUTPUT

A BLANK ENTRY INDICATES THAT THE FUNCTION IS NOT OFFERED.

CURRENT		ISOLATION			
SINK	SOURCE	TYPE	VOLTAGE	PRICE	COMMENTS
100 mA	OC, PR			—	ADJUSTABLE THRESHOLD; EIGHT I/O LINES REQUIRED FOR HANDSHAKE
—	—			—	TWO PROGRAMMABLE TIMERS
				—	
				—	
2A	2A	RELAY	—	—	
2A	2A	RELAY	—	—	
24 mA	2.6 mA			$225	OPTO-22/POTTER AND BRUMFIELD COMPATIBLE
—	—	—	—	—	
—	—	OPTO	1 kV	$2150	DMA CAPABILITY; FOUR PROGRAMMABLE TIMERS
64 mA	—	OPTO	—	$1140	FOUR PROGRAMMABLE TIMERS
—	—			$1195	OPTO-22 COMPATIBLE; FOUR PROGRAMMABLE TIMERS
—	—			—	PIGGYBACK MODULE FOR INTELLIGENT I/O OR CPU CARD
100 mA	OC, PR			—	OPTO-22 COMPATIBLE; ADJUSTABLE INPUT THRESHOLD
800 mA (TYP) 48 mA	— OC	OPTO	2.5 kV	—	TWO PROGRAMMABLE TIMERS
—	—			—	TWO PROGRAMMABLE TIMERS
1.5A	—	OPTO	1.5 kV	$645	ADJUSTABLE INPUT THRESHOLD
—	—			$1245	INTELLIGENT MULTIFUNCTION I/O BOARD; OPTO-22 COMPATIBLE
48 mA —	15 mA —			$595	OPTO-22 COMPATIBLE; TWO PROGRAMMABLE TIMERS
48 mA	10 mA			—	OPTO-22 COMPATIBLE; TWO PROGRAMMABLE TIMERS
—	—			—	OPTO-22 COMPATIBLE; TWO PROGRAMMABLE TIMERS; TWO SERIAL PORTS
15 mA (TYP)	—	OPTO	—	—	TWO PROGRAMMABLE TIMERS
48 mA	10 mA			—	OPTO-22 COMPATIBLE; PROTOTYPING AREA; PROGRAMMABLE TIMER
—	—			—	TWO PROGRAMMABLE TIMERS
IEEE-488	IEEE-488			$1125	THREE PROGRAMMABLE TIMERS
—	—			DM 870	TWO SERIAL PORTS
—	—	OPTO	—	$840	
				$440	
		OPTO	300V	$495	
25 mA	—			$365	
250 mA	—	OPTO	300V	$410	
		OPTO	3 kV	$695	
		OPTO	3 kV	$795	
				$595	
				$695	ADJUSTABLE INPUT THRESHOLD
				$695	CONTACT-BOUNCE ELIMINATOR
		OPTO	—	$895	
		OPTO	—	$795	

Table continued on pg 210

VME BUS DIGITAL I/O BOARDS *(Continued)*

			NUMBER OF LINES				INPUT	OUTPUT
MANUFACTURER	MODEL NUMBER	EUROCARD SIZE	INPUT	OUTPUT	INPUT/ OUTPUT	HAND- SHAKE	DC VOLTAGE*	DC VOLTAGE*
SCIENCE APPLICATIONS INTERNATIONAL	SAIVME-1180	D	32				5 TO 48V	
	SAIVME-2010	D		16				5 TO 280V AC
	SAIVME-2120	D		64				70V
	SAIVME-2132	D		64				−60V
	SAIVME-2170	D		32				30V 50V
	SAIVME-2200	D		32				350V DC, AC PEAK
	SAIVME-2510	D			64		TTL	TTL OR OC
	SAIVME-2511	D			48		TTL	TTL
	SAIVME-2528	D			128		TTL	TTL
	SAIVME-2532	D	32		32		5 TO 48V	70V
SYSTEM FORSCHUNG	MPVME-1200	D			32	4	TTL	TTL
THOMSON SEMICONDUCTORS	TSVME400	D	48					12 TO 24V
	TSVME401	D		32				150V
	TSVME405	D			88	16	IEEE-488	IEEE-488
URTEC	3U01	S		88		—		—
XYCOM	XVME-210	D	32			—	—	
	XVME-220	D		32				30V
	XVME-240	D	8	8	64	—	TTL	TTL
	XVME-260	D		32				—

* UNLESS OTHERWISE SPECIFIED

KEY:

—	INFORMATION NOT PROVIDED	PR	PULLUP RESISTOR
D	DOUBLE-HEIGHT	S	SINGLE-HEIGHT
IEEE-488	IEEE-488-COMPATIBLE DRIVER/RECEIVER	TTL	TTL-COMPATIBLE INPUT OR OUTPUT
OC	OPEN-COLLECTOR OUTPUT		
OPT	OPTIONAL		
OPTO	OPTICALLY COUPLED		

A BLANK ENTRY INDICATES THAT THE FUNCTION IS NOT OFFERED.

MULTIBUS II DIGITAL I/O BOARDS

			NUMBER OF CHANNELS				INPUT	OUTPUT		
									CURRENT	
MANUFACTURER	MODEL NUMBER	EUROCARD SIZE	INPUT	OUTPUT	INPUT/ OUTPUT	HAND- SHAKE	DC VOLTAGE*	DC VOLTAGE	SINK	SOURCE
EFISYSTEME	CESD-2/01	D+			64	—	5 TO 220V DC, AC	—	—	—
CONCURRENT TECHNOLOGIES	CP-186/10	D+			48	—	TTL	TTL	—	—
	IO-188/120	D+	24	24	72	—	TTL	TTL	—	—

*UNLESS OTHERWISE SPECIFIED.

KEY:

—	INFORMATION NOT PROVIDED
D+	DOUBLE EXTENDED EUROCARD
OPTO	OPTICALLY COUPLED
RTC	REAL-TIME CLOCK
TTL	TTL-COMPATIBLE INPUT OR OUTPUT

A BLANK ENTRY INDICATES THAT
THE FUNCTION IS NOT OFFERED.

CURRENT SINK	CURRENT SOURCE	ISOLATION TYPE	ISOLATION VOLTAGE	PRICE	COMMENTS
				$595	
1A	—	OPTO	—	$695	
600 mA	—			$695	5, 12, 24, AND 48V SOLID-STATE SWITCH OPTIONS
	−50 mA			$695	TELECOMMUNICATIONS-RELAY-DRIVER OUTPUTS
2.5 mA 300 mA	— —	OPTO		$795	
1A	1A	RELAY		$895	MERCURY-WETTED 50-VA RELAYS (0.5A MAX SWITCHING)
64 mA	—			$695	
2.4/8.8 mA 64 mA (OPT)	— 15 mA (OPT)			$695	OUTPUT ONLY WITH 64/15-mA SINK/SOURCE BUFFERED-OUTPUT OPTION
24 mA	6.5 mA			$995	
600 mA	—			$595	
—	—	OPTO (OPT)		—	TWO PROGRAMMABLE TIMERS
—	—	OPTO	1.5 kV	—	DEBOUNCED INPUTS, COMPATIBLE WITH PROXIMITY DETECTORS
2A	2A	RELAY	1 kV	—	OPTIONAL 12-BIT D/A CONVERTER
IEEE-488	IEEE-488			—	FOUR PROGRAMMABLE TIMERS
—	—			—	
		OPTO	—	—	DEBOUNCED INPUTS
100 mA	—	OPTO	—	—	
—	—			—	
—	—	RELAY	—	—	

ISOLATION TYPE	ISOLATION VOLTAGE	PRICE	COMMENTS
OPTO	—	(AVAIL Q2 '86)	EXTERNAL SIGNAL CONDITIONING; BUILT-IN SELF TEST; TWO iSBX CONNECTORS
		—	iAPX186-BASED MULTIFUNCTION CPU; TWO iSBX CONNECTORS
		—	iAPX188-BASED INTELLIGENT I/O; TWO SERIAL PORTS; FIVE TIMERS; RTC

Tables continued on pg 212

VME BUS SPECIALIZED I/O BOARDS

MANUFACTURER	MODEL NUMBER	EUROCARD SIZE	DESCRIPTION	PRICE	COMMENTS
COMPUMOTOR CORP	1830	D	INTELLIGENT STEPPER-MOTOR INDEXER	$1395	1-MHz PULSE OUTPUT; OPEN- OR CLOSED-LOOP OPERATION
DATACUBE	DIGIMAX	D	6- OR 8-BIT VIDEO-SIGNAL A/D AND D/A CONVERTER	—	7.16-MHz SAMPLE RATE; EIGHT RS-170 INPUTS; RS-170 RGB OUTPUT; FRONT AND BACK END TO VME BUS MAXVIDEO IMAGE-PROCESSING SYSTEM
DATA SUD SYSTEMS	DSSEVIDEO-56/-58	—	6- OR 8-BIT IMAGE-DIGITIZING MODULE	—	FOUR RS-170 INPUTS; 50-Hz/625-LINE OR 60-Hz/525-LINE OPERATION; INPUT LOOK-UP TABLE (SOLD ONLY AS PART OF DSSE IMAGE-PROCESSING SYSTEM)
DATA TRANSLATION	DT1451	D	8-BIT FRAME GRABBER AND FRAME STORE	—	512x512-PIXEL RESOLUTION; 2-FRAME RAM BUFFER; RGB OUTPUT
DIGITAL GRAPHIC SYSTEMS	SERIES 8000	D	6- OR 8-BIT FRAME GRABBER AND FRAME STORE	$4000	9.7-MHz SAMPLE RATE; FOUR RS-170 INPUTS; RS-170 MONOCHROME (RGB OPT) OUTPUT; 256/384/512 PIXELS/LINE; 256/512 LINES/FRAME
IMAGING TECHNOLOGY	FG-100-V	D	8-BIT FRAME GRABBER AND FRAME STORE	—	RS-170/330 (OR 50-Hz CCIR) INPUT; RS-170 MONOCHROME OR RGB OUTPUT; INPUT/FEEDBACK AND OUTPUT LOOK-UP TABLES; 512x512x12-BIT STORE
IRONICS	IV-1652	D	8-BIT FRAME COMBINER AND CAMERA-INPUT INTERFACE	—	20-MHz SAMPLE RATE; RS-170 OR HIGHER-RESOLUTION INPUT; INPUT AND OUTPUT LOOK-UP TABLES; SEPARATE DIGITAL VIDEO INPUT; RGB OUTPUT
	IV-1666	D	DUAL-AXIS SERVO CONTROLLER	—	TWO 24-BIT UP/DOWN-COUNTER ENCODER INPUTS; SWITCH I/O SUPPORT AND A/D CONVERSION
	IV-1667	D	BIPOLAR DC MOTOR DRIVER	—	±24V TO ±48V OUTPUTS; 50A CONTINUOUS, 100A PULSED OUTPUT; OPTICAL ISOLATION
	IV-1668	D	QUAD-AXIS POWER CONTROLLER	—	±24V TO ±48V OUTPUTS; 10A CONTINUOUS, 40A PULSED, PER CHANNEL; OPTICAL ISOLATION
JANZ COMPUTER	VDR-18	D	AUTONOMOUS MACHINE/PROCESS CONTROLLER	—	Z8002 CPU; FOUR ANALOG INPUTS; FOUR 12-BIT ANALOG OUTPUTS; EIGHT OPTOCOUPLED INPUTS AND OUTPUTS; 500-mA DRIVERS; TIMERS AND SERIAL PORTS
MATRIX	MS-SSC	S	SINGLE STEPPER-MOTOR CONTROLLER	$795	STEP RATES FROM 13 Hz TO 10 kHz; FULL- OR HALF-STEP OPERATION; FIVE DIGITAL INPUTS; FOUR AUXILIARY OUTPUTS
	MS-DSC	S	DUAL STEPPER-MOTOR CONTROLLER	$995	STEP RATES FROM 13 Hz TO 10 kHz; FULL- OR HALF-STEP OPERATION; FIVE DIGITAL INPUTS; FOUR AUXILIARY OUTPUTS
MICROVOICE	MV1500	D	DIGITAL AUDIO-PLAYBACK BOARD	—	ADPCM SPEECH DECODER; Z80 CPU; SERIAL AND PARALLEL PORTS
PEP MODULAR COMPUTER	VCCD	S	CCD CAMERA INTERFACE	—	TO 20-MHz SAMPLE RATE; 1-CHANNEL MONOCHROME OR 3-CHANNEL RGB OPERATION; PROGRAMMABLE THRESHOLD FOR SINGLE-BIT CONVERSIONS
PRIMAGRAPHICS	VVI-7	D	7-BIT FRAME GRABBER	£1000	15-MHz SAMPLE RATE; THREE COMPOSITE VIDEO INPUTS; DMA TO MEMORY; 575x768-PIXEL RESOLUTION; INTERLACED SCAN
SCIENCE APPLICATIONS INTERNATIONAL	SAIVME-1140	D	PULSE-RATE INPUT MODULE	$695	FOUR INPUT CHANNELS; TTL 5 TO 48V DC, OR OPTOCOUPLED 5 TO 240V INPUTS; INTERRUPT ON COUNTER FULL
	SAIVME-4900	D	DIGITAL-TO-SYNCHRO/RESOLVER CONVERTER MODULE	$1395 TO $3795	14-BIT CONVERTER; 3- OR 4-WIRE OUTPUT; INTERNAL TRANSFORMER (400-Hz OPTION); 1.5-VA OR 4.5-VA OUTPUTS (DUAL SLOT WITH 4.5-VA OPTION)

KEY:

— INFORMATION NOT PROVIDED
D DOUBLE-HEIGHT
S SINGLE-HEIGHT

Table continued on pg 214

THE BUS ARCHITECTURE CAREER COMPATIBILITY TEST.

CIRCLE NO 207

VME BUS SPECIALIZED I/O BOARDS *(Continued)*

MANUFACTURER	MODEL NUMBER	EUROCARD SIZE	DESCRIPTION	PRICE	COMMENTS
SCIENCE APPLICATIONS INTERNATIONAL	SAIVME-4905	D	HIGH-POWER DIGITAL-TO-SYNCHRO/RESOLVER CONVERTER MODULE	$1695 TO $2595	14-BIT CONVERTER; 3- OR 4-WIRE OUTPUT; INTERNAL TRANSFORMER (400-Hz OPTION); 5-VA OUTPUTS
	SAIVME-4910	D	SYNCHRO/RESOLVER-TO-DIGITAL CONVERTER MODULE	$1395	10-, 12-, OR 14-BIT CONVERTER; 3-WIRE SYNCHRO + REFERENCE OR 4-WIRE RESOLVER + REFERENCE; INTERNAL TRANSFORMERS FOR 60 Hz, 400 Hz, 2.6 kHz
	SAIVME-4920	D	DUAL-CHANNEL SYNCHRO/RESOLVER-TO-DIGITAL CONVERTER	$895 TO $2595	10-, 12-, OR 14-BIT CONVERTER; 3-WIRE SYNCHRO OR 4-WIRE RESOLVER; INTERNAL TRANSFORMERS FOR 60 Hz, 400 Hz, 2.6 kHz
	SAIVME-4940	D	QUAD-CHANNEL RESOLVER-TO-DIGITAL CONVERTER	$1795 TO $2895	10-, 12-, 14-, OR 16-BIT RESOLUTION; 16-BIT PITCH COUNTER PER CHANNEL; 400-Hz TO 2.6-kHz, 2.6- TO 5-kHz, 5- TO 10-kHz FREQUENCY OPTIONS
SKY COMPUTERS	SKYFRAME-VME	D	FRAME GRABBER AND FRAME STORE	—	CAMERA OR VIDEO SIGNAL INPUT; MONOCHROME OR COLOR OUTPUT
URTEC	3US1	S	LCD INTERFACE	—	
	3UP2-FR1	S	500-Hz TO 10-MHz FREQUENCY MEASURING MODULE	—	107 RESOLUTION; 10 SAMPLES/SEC
XYCOM	XVME-230	D	INTELLIGENT COUNTER MODULE	—	FOUR TO 16 CHANNELS; COUNT RATES TO 5 MHz; PERIOD, FREQUENCY, POSITION, EVENT-COUNT MEASUREMENT, PULSE-WIDTH MODULATION, STEPPER MOTOR CONTROL

KEY:

— INFORMATION NOT PROVIDED
D DOUBLE-HEIGHT
S SINGLE-HEIGHT

MULTIBUS II SPECIALIZED I/O BOARDS

MANUFACTURER	MODEL NUMBER	EUROCARD SIZE	DESCRIPTION	PRICE	COMMENTS
CENTRALP AUTOMATISMES	NEX-MTB-II-001	D+	VIDEO DATA-ACQUISITION BOARD	Frfr 40,000(AVAIL Q3 '86)	20-MHz 8-BIT A/D CONVERTER; iLBX 32-BIT DATA TRANSFER TO MEMORY

KEY:

D+ DOUBLE EXTENDED EUROCARD

DO YOU ENJOY SPENDING NIGHTS AND WEEKENDS ALONE CONFIGURING YOUR SYSTEM?

Career Compatibility Test

Bus Capability	*VME**	*MB II*	*Mark Your Preference*
Geographic Addressing		*X*	
Built-in Self-Test		*X*	
Software Configurability		*X*	

Do you enjoy hunting down a misplaced or missing jumper at 2 o'clock Saturday morning?

If so, don't choose the MULTIBUS® II architecture.

Because the MULTIBUS II architecture has an exclusive feature that reduces or eliminates jumpers and dip switches.

It's called geographic addressing. And it allows boards to be addressed by slot number in software, which eliminates or greatly reduces jumpers. For example, there are no jumpers on the entire line of MULTIBUS II memory boards.

But if you do need jumpers, geographic addressing can still help. Because software can use it to verify correct jumper placement.

And not only is board configuration fully supported in software, but so is identification of board type, manufacturer and the revision level of both hardware and firmware. Geographic addressing also provides a capability for built-in self-test and remote system diagnostics.

Making things a lot easier for you. And resulting in lower test costs and improved serviceability.

But, by all means, if you enjoy tearing your hair out while re-reading the manual for the umpteenth time, catch the other bus.

It doesn't have geographic addressing, so you could find yourself knee deep in jumper and testing problems. Which means you'll spend many long, gratifying nights working at your bench.

Now, indicate your bus choice in the preference box and turn the page.

*Source: IEEE P1014 Draft 1.2, August 1985.

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13-BIT RESOLUTION
16 SE OR 8 DE INPUTS
±5 VOLT INPUT
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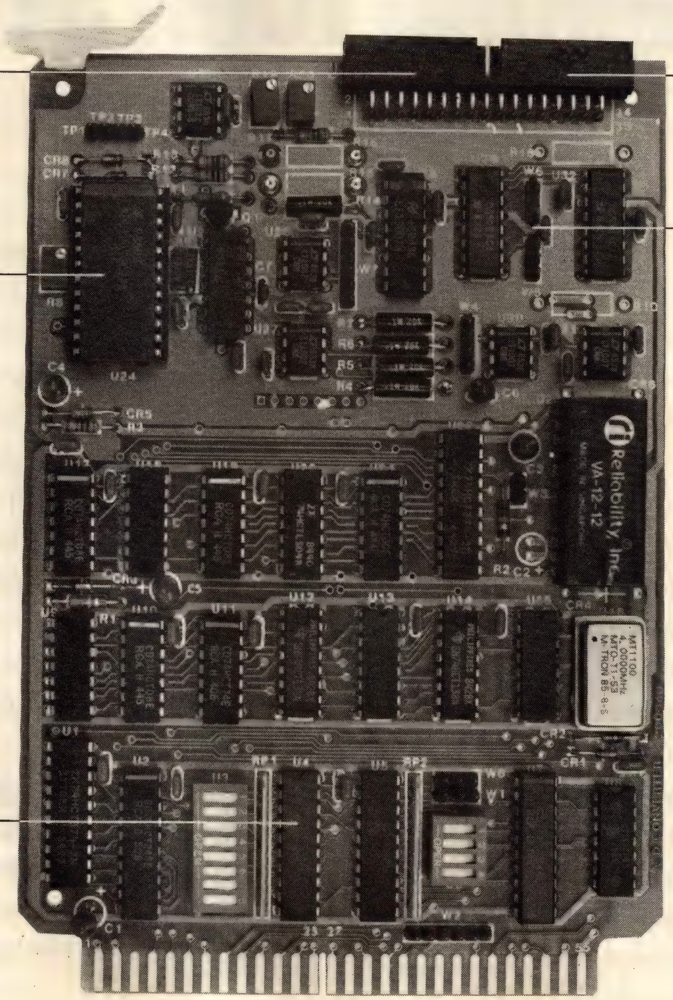

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CIRCLE NO 107

DO YOU LIKE THE CHALLENGE OF RELIABILITY PROBLEMS?

Career Compatibility Test

Bus Capability	*VME**	*MB II*	*Mark Your Preference*
Power and Ground Pins (PI Connector)	*14*	*30*	
Synchronous Protocol		*X*	
Bus Parity		*X*	

Somebody switches on a compressor and your computer system dies.

Swell. Is that the kind of career challenge you got into the systems design business for?

If so, don't choose the MULTIBUS® II architecture. Because MULTIBUS II systems ensure reliability in three ways.

First, a large number of power and ground pins provides superior signal quality.

Then synchronous protocol gives you increased noise immunity. And protects you from metastability problems.

Finally, bus parity protects against disturbances on any line. Whether it's address, data or control.

On the other hand, if dealing with reliability problems gets your blood pumping, the other bus should give you plenty of satisfying excitement.

It has only 14 power and ground pins compared to 30 on the MULTIBUS II boards. And it doesn't offer you the protection of synchronous operation or bus parity. Which means metastability becomes something to watch out for. The other bus can be very challenging indeed.

Indicate your preference and continue.

*Source: IEEE P1014 Draft 1.2, August 1985.

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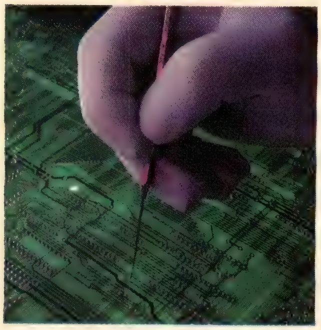
CIRCLE NO 209

No "boomerang effect" at Trend Circuits. Less than 1% of our prototype boards ever come back.

Fast turnarounds in prototype circuit boards are great — but not when the boards circle back again and again because of poor quality.



That "boomerang effect" costs precious time in proving your concepts and can end your chances to meet critical market windows.

We deliver speed *and* quality.

Speedy turnarounds don't count for much if prototypes don't work. At Trend Circuits, we're specialists in rapid production of prototype boards that work first time out. That's because we're people who understand your language, your objectives and your pressures.

Further, fully one-third of our people are involved in inspection. We begin with incoming artwork, where we can quickly identify common design errors. And we continue with double- and triple-checking right through to completion. As a result, less than a scant 1% ever come back. And that's good for both of us.

Now for speed. On a regular basis, we deliver *double-sided boards within 24 hours, and multi-layer boards within five days.* In fact, we're completing no less than 82% of all our work within five days.

Check our references.

You can verify our facts easily enough by talking to our customers. Simply phone and we'll put you in touch with people who've decided they won't accept compromise in quickly moving from design to finished prototype. They'll tell you why we're their logical choice for "no-boomerang" boards. And why we should be yours.

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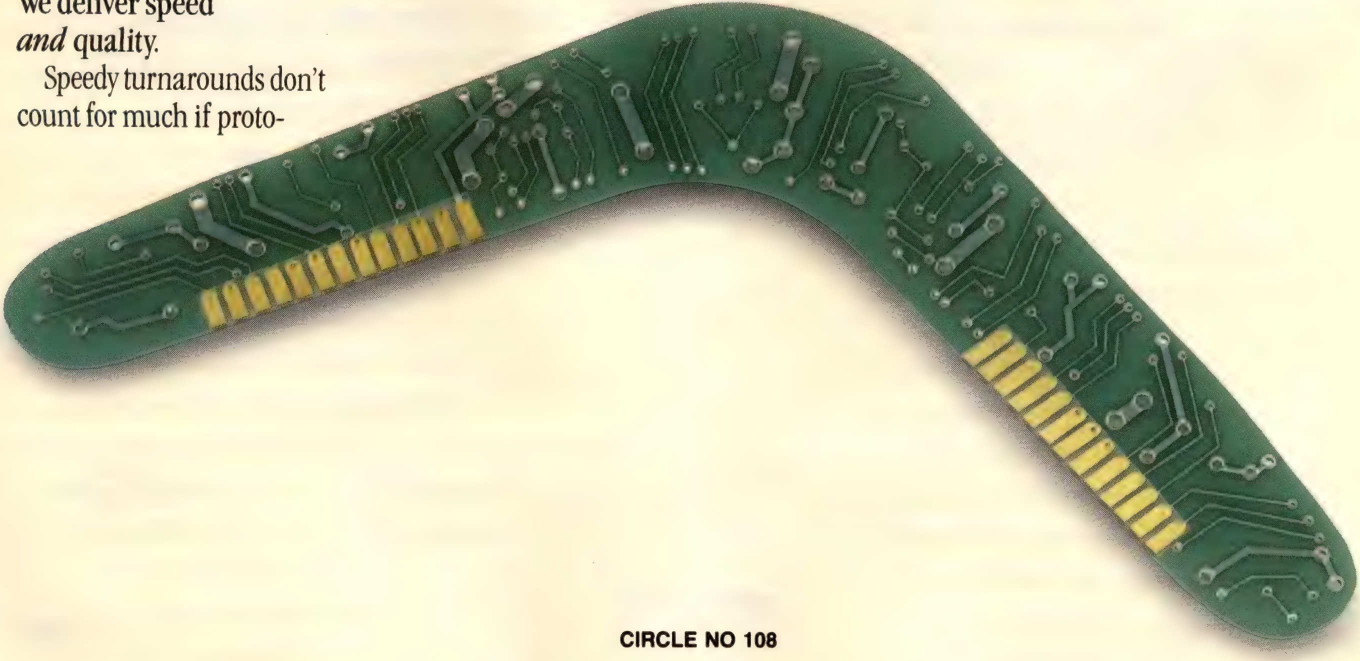

CIRCLE NO 108

DO YOU CHERISH MULTIPROCESSING LIMITATIONS?

Career Compatibility Test

Bus Capability	*VME**	*MB II*	*Mark Your Preference*
Virtual Interrupts		*X*	
Number of Interrupt Levels	*7*	*255*	
Distributed Arbitration		*X*	
Number of Arbitration Levels	*4*	*20*	

Does the anguish of running out of interrupts give you a masochistic sense of pleasure?

If so, stay away from the MULTIBUS® II architecture.

Because of its virtual interrupt feature, MULTIBUS II boards give you all the sources and destinations of interrupt you need for multiprocessing. Up to 255.

And to make it an even stronger candidate for multiprocessing, the MULTIBUS II architecture features distributed arbitration. Which assures that no single board can hog the bus. In fact, MULTIBUS II systems are so flexible they can easily accommodate up to 20 bus masters.

Of course, if you believe that needless frustration builds character, you should choose the other bus.

You'll be stuck with a dedicated interrupt arrangement that effectively allows you only seven interrupts. And because it uses central arbitration, you're effectively limited to only four masters.

Of course, if you want to design systems that are more powerful, useful and flexible, you should choose the MULTIBUS II architecture.

Now turn to the last page and complete the test.

*Source: IEEE P1014 Draft 1.2, August 1985.

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CIRCLE NO 210

FIRST VECTORBORD®, NOW VMEbus.

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For 40 years Engineers have relied on **Vector** to provide innovative, quality products that make their job easier and get their designs to market faster.

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Our **Backplanes** have less crosstalk, superior power/ground distribution and are designed for both high and low speed applications. We even have 21 slot backplanes.

Vector's **Subracks** are simpler to assemble and our **Divider Kits** enable you to configure subracks to the number of slots you need. Our innovative depth divider kits allow you to mount different length and height cards on the same backplane.

Our Euro sized **Prototyping Cards** are available in different patterns on .1 grid that allow for non-restricted component placement. Power and ground planes surround all DIN connector pins allowing easy, direct connection of any pin to power or ground.

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CIRCLE NO 109

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DO YOU THINK GUARANTEED COMPATIBILITY IS FOR SISSIES?

Career Compatibility Test

Bus Capability	*VME**	*MB II*	*Mark Your Preference*
Synchronous Protocol		*X*	
Spec Options	*Many*	*Few*	

When a board from manufacturer X doesn't work with a board from manufacturer Y, do you secretly get a perverse sense of delight?

If so, you won't be happy with the MULTIBUS® II architecture.

Since it has a synchronous protocol. Which not only provides noise immunity, but compatibility as well.

In fact, synchronous protocol, because of the very rigorous definition it requires in specs, virtually guarantees compatibility among MULTIBUS II boards from different vendors. And across many generations of VLSI. Assuring a long life for your products.

The other bus has a very unconstrained asynchronous protocol. With lots of spec options. Which gives board manufacturers lots of "leeway." So all sorts of delightfully unpredictable things can happen. For instance, bus timing can change when boards are added or removed from the backplane. Signal edge rates can change too. And options can lead to incompatibilities.

Of course, maybe you think putting up with that kind of frustration is what you trade for higher performance.

Not so. The MULTIBUS II architecture can run faster than the other bus.

So mark your preference now. We'll wait. Then put your pencil down because this is the end of the test.

If you chose the MULTIBUS II architecture more often, read on. If you chose the other bus more often, you might consider a new career direction (or a good course in stress management).

Still with us? Good. Want to learn more? Then call or write for our MULTIBUS II Technical Series: Intel Corporation, Lit. Dept. W262, 3065 Bowers Ave., Santa Clara, CA 95051.

Or call toll-free now at (800) 538-1876.

It's the best career move you can make.

intel®

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CIRCLE NO 106

Your VME system just got faster.

Eleven new VMEbus modules from Dual can make your 32-bit designs take off. Today.

Dual's full line of VMEbus modules is setting new performance and packaging standards in the 32-bit world. Especially among applications that demand high system throughput, fast I/O processing and heavy disk usage.

For performance, start with our multiprocessor engine, the VMPU-32, based on Motorola's advanced MC68020. Optimized for virtual memory UNIX environments, it features extensive interprocessor communication capabilities, a full megabyte of dual-ported local memory, and up to 32 Kbytes of EPROM.

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These modules are all fully ruggedized, housed in a standard VME backplane, and run under a system controller featuring fast 96ns arbitration. For software support, our implementation of UNIX System V, Release 2.0, Version 2 is available.

So why waste time developing your own 32-bit VMEbus solutions when ours are ready to go? For full details, contact: Dual Systems Corporation, 2530 San Pablo Ave., Berkeley, CA 94702. (415) 549-3854. Telex 230199 SWIFT.

THERE'S ONLY ONE

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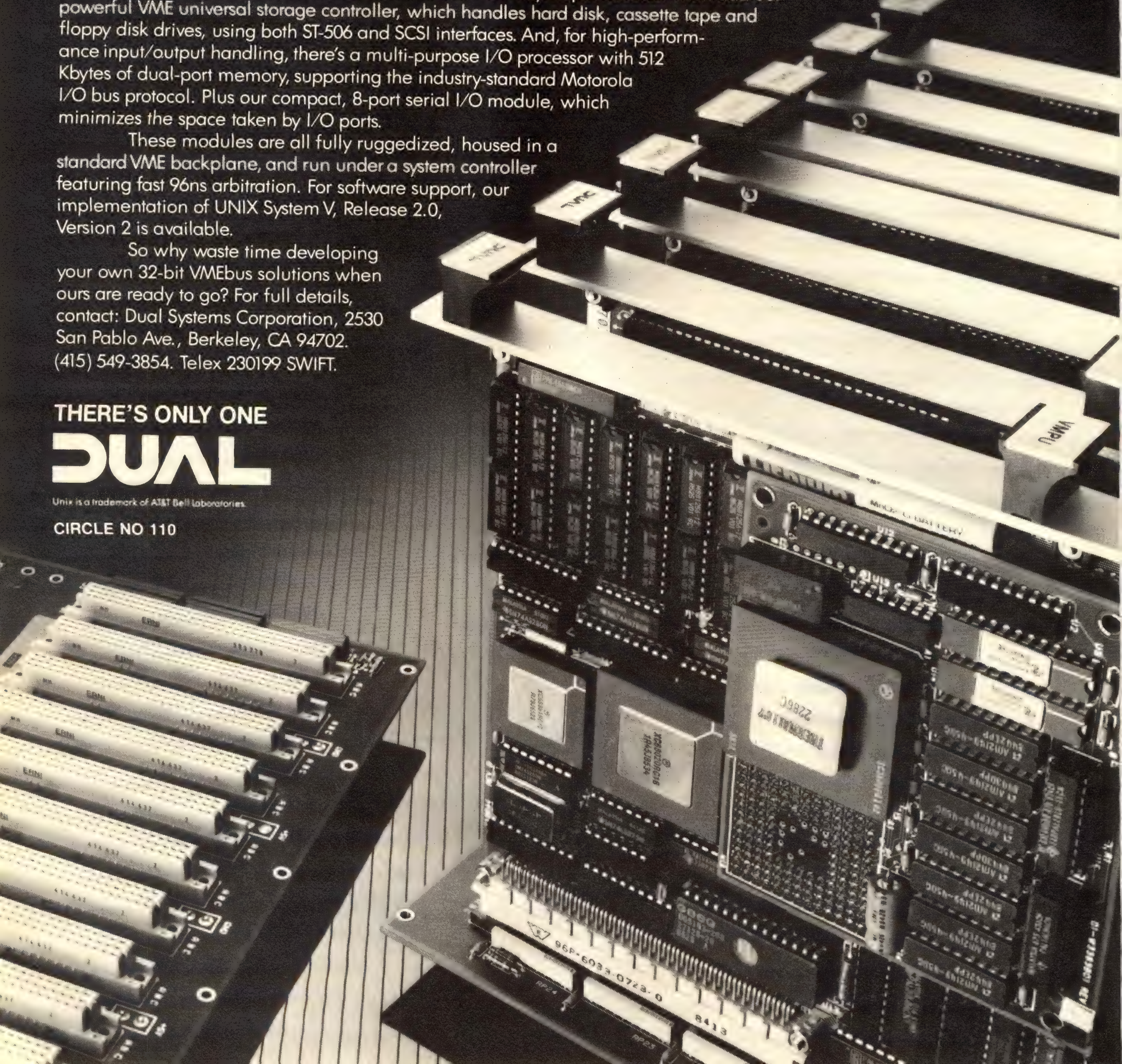
CIRCLE NO 110



Diverse circuits exploit matching in quad-transistor IC

You can exploit the close parameter matching of the transistors in a quad-transistor array to realize a variety of circuit applications. The low offset-voltage differentials and tight beta matching make the IC suitable for linear circuits, and the low bulk resistance suits the array to logarithmic applications.

Art Kapoor and Derek Bowers,
Precision Monolithics Inc

The performance of some specialized transistor-based amplifiers relies heavily on good matching of transistor parameters. The MAT-04, a monolithic quad transistor, provides very close matching for such specialized circuits. A voltage-controlled attenuator, a high-speed instrumentation amplifier, and an ac preamplifier are types of circuits that exploit the array's matching characteristics. In addition to close parameter matching, the transistors in the MAT-04 have low bulk resistance, making them suitable for such logarithmic applications as a vector summer, a squaring circuit, and a square-root circuit.

Voltage-controlled attenuation is an appropriate application for a matched-transistor array. For example, the voltage-controlled attenuator (VCA) shown in **Fig 1**, widely used in professional-audio circles, is difficult to implement using discrete transistors because of distortion induced by mismatched transistor parameters. The close parameter matching of the transistors in the MAT-04 allows the VCA to provide low-distortion attenuation over a wide range of control voltages. You could use the VCA, for example, as a low-distortion gain control in an audio amplifier.

The VCA's design is based on the amplifying characteristics of a differential transistor pair. **Fig 2** shows the classic differential pair. When there's no voltage difference between the input terminals ($V_{IN}=0$), the currents in both sides of the differential pair are equal; the differential output voltage is therefore 0V. Small changes in V_{IN} cause an imbalance in the currents flowing through the two sides of the differential pair, and the imbalance results in an amplified differential output. The total stage current (I) of the differential pair is constant regardless of the input voltage. Matching of the transistors in a differential pair is critical, because device mismatches cause dc errors and upset linearity.

In **Fig 1**'s VCA, the input signal modulates the stage current of each differential pair. Op amps IC_2 and IC_3, in conjunction with transistors Q_5 and Q_6, form voltage-to-current converters that transform a single-ended input voltage into differential currents that are the stage currents (I_A and I_B) of each differential pair.

The transfer functions for the voltage-to-current converter are $I_A=-V_{IN}/R_2$ and $I_B=V_{IN}/R_5$. You can use

A matched-parameter, quad-transistor array allows you to design linear circuits that outperform circuits using discrete, unmatched transistors.

low-cost, unmatched transistors for Q_5 and Q_6, as they're inside the feedback loops of IC_2 and IC_3; their beta mismatch has minimal effect on the output offset.

If all the bases of the MAT-04 in **Fig 1** are at ground potential, the stage currents of each differential pair split equally between both transistors. The MAT-04's output comes from one side of each differential pair (from the collectors of Q_2 and Q_3). Unity-gain op amp IC_1 converts this output to a single-ended signal. Assuming the bases of the MAT-04 are at ground potential, the gain of the overall circuit is

$$\frac{V_{OUT}}{V_{IN}} = \frac{1}{2}\left[\frac{V_{IN}R_6}{R_5}\right] - \left[-\frac{1}{2}\left(\frac{V_{IN}R_4}{R_2}\right)\right]$$

$$= V_{IN}\frac{R_2R_6 + R_4R_5}{2R_2R_5},$$

and, because $R_2=R_4=R_5=R_6$, $V_{OUT}/V_{IN}=1$.

When you apply a positive control voltage to the VCA, most of the differential pairs' stage currents are diverted to transistors Q_2 and Q_3, and the net result is an increase in circuit gain. When you apply a negative control voltage, however, most of the pairs' stage currents are diverted to transistors Q_1 and Q_4, and the result is a reduction in the circuit's gain.

The (theoretically) ideal transfer function for the voltage-controlled attenuator is

$$\frac{V_{OUT}}{V_{IN}} = \frac{2}{1 + \exp\left\{\left(-V_{CONTROL} \times \frac{R_{14}}{R_{13}+R_{14}}\right) \div \frac{kT}{q}\right\}},$$

where

- k=Boltzmann's constant=1.38×10^{-23}J/°K
- T=temperature in °K
- q=electron charge=1.602×10^{-19} coul.

You can see from the transfer function that the maximum gain of the circuit is 2 (or 6 dB). **Fig 3** shows

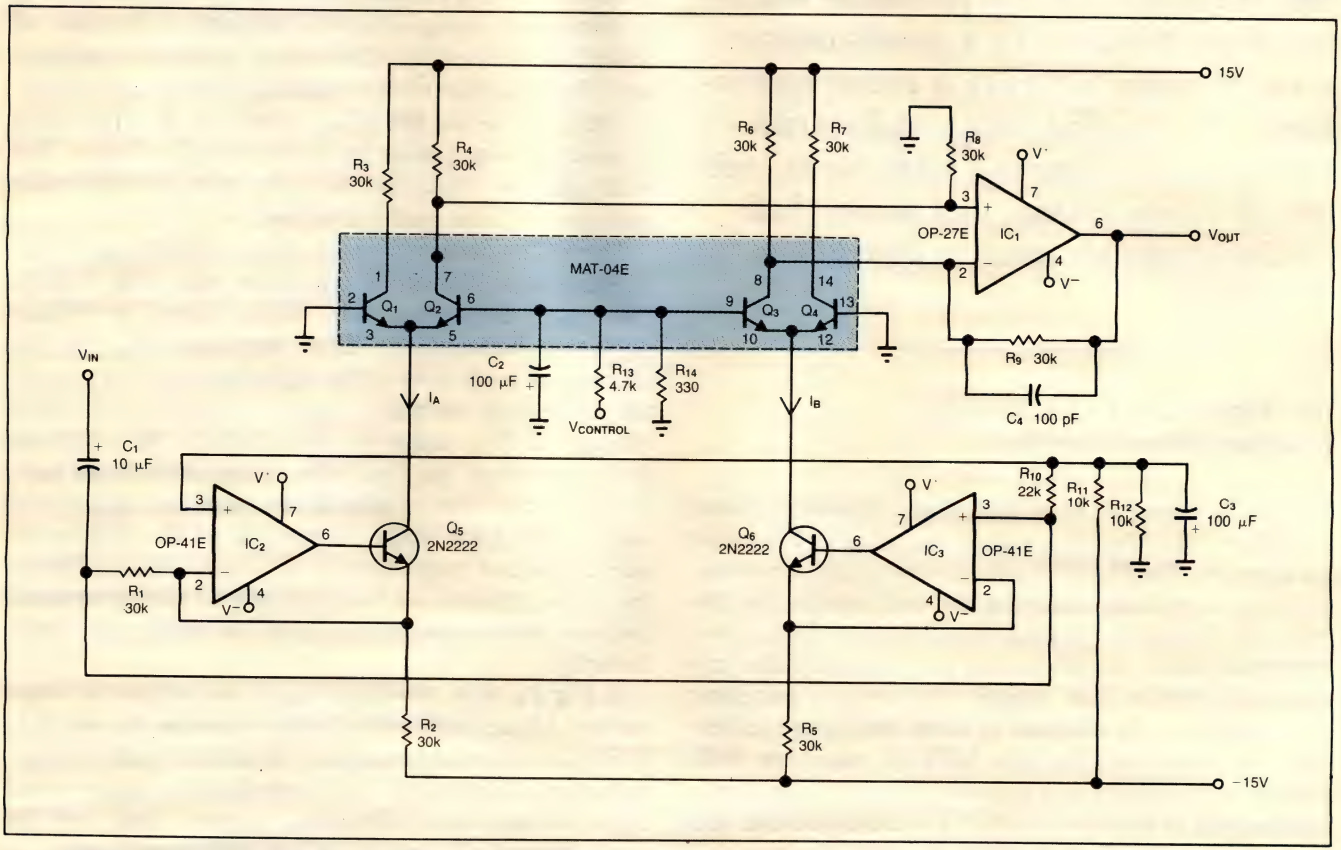


*Fig 1—**This voltage-controlled attenuator uses a dc voltage** to provide distortion-free attenuation over a 60-dB dynamic range. The circuit works by modulating the normally balanced stage currents in a differential transistor pair. The attenuator easily meets high-fidelity standards for distortion, bandwidth, and noise level.*

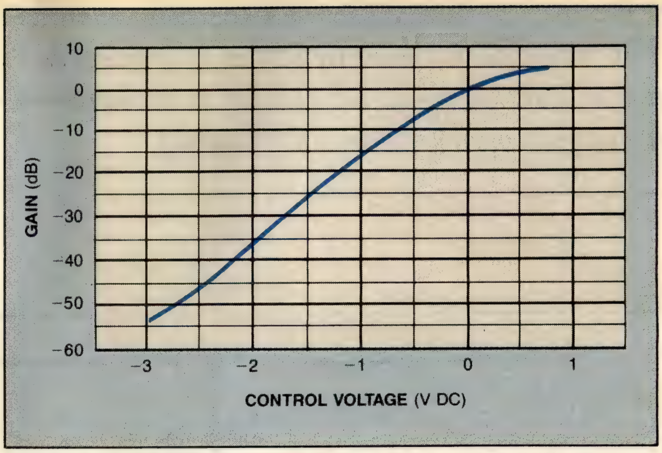


*Fig 3—**A 1000:1 gain reduction results** when you change the control voltage from 1V to −3V in the circuit shown in **Fig 1**. The circuit's maximum gain of 2 occurs when you apply 1V. The gain drops to about −50 dB when the control voltage is −3V.*

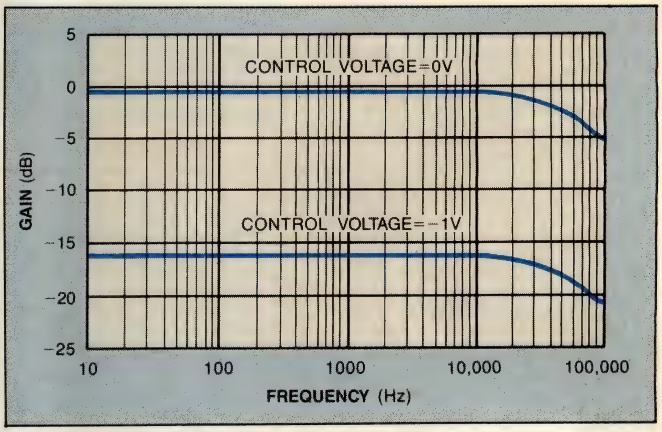


*Fig 4—**Frequency response is independent of gain** in the voltage-controlled attenuator of **Fig 1**. Moreover, the bandwidth of the attenuator easily meets the standards of high-fidelity systems.*

the increase in attenuation as the control voltage becomes more negative. The VCA accepts a 3V rms input and easily accommodates the full 20-Hz to 20-kHz audio bandwidth, as shown in **Fig 4.** Distortion is typically less than 0.03%, and the noise level is at least 110 dB below the maximum output.

To ensure the best performance, resistors R_2 through R_7 in **Fig 2**'s circuit should be metal-film units that spec a 1% tolerance. Because small amounts of reverse bias can be present on C_2 when the control voltage is positive, you should use a nonpolarized tantalum capacitor for C_2.

If you need a low-noise, high-speed instrumentation amplifier for use in high-precision transducer and professional-audio applications, consider the circuit shown in **Fig 5.** The circuit uses an OP-17 high-speed op amp, preceded by an input amplifier that comprises a MAT-02 matched-transistor pair, a MAT-04 quad-transistor array, and associated circuitry. The configuration of the MAT-04, known as a "linearized cross quad," acts as a voltage-to-current converter that provides feedback to the input stage.

The OP-17 serves as an overall nulling amplifier to complete the feedback loop. Resistor pairs R_1-R_2 and R_3-R_4 form voltage dividers that attenuate the output-voltage swing (attenuation is necessary because the cross-quad arrangement has a limited input range). Zener diode D_1 sets the bias point for the input stage. Because of the zener diode's soft-knee characteristic, the effective zener voltage is about 3.3V at low currents. The 3.3V bias results in a bias current of 530 μA per side for the input stage.

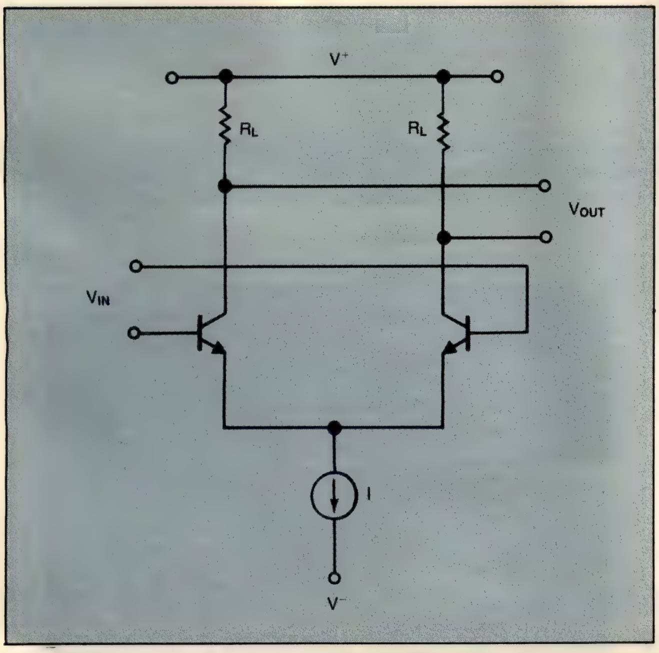


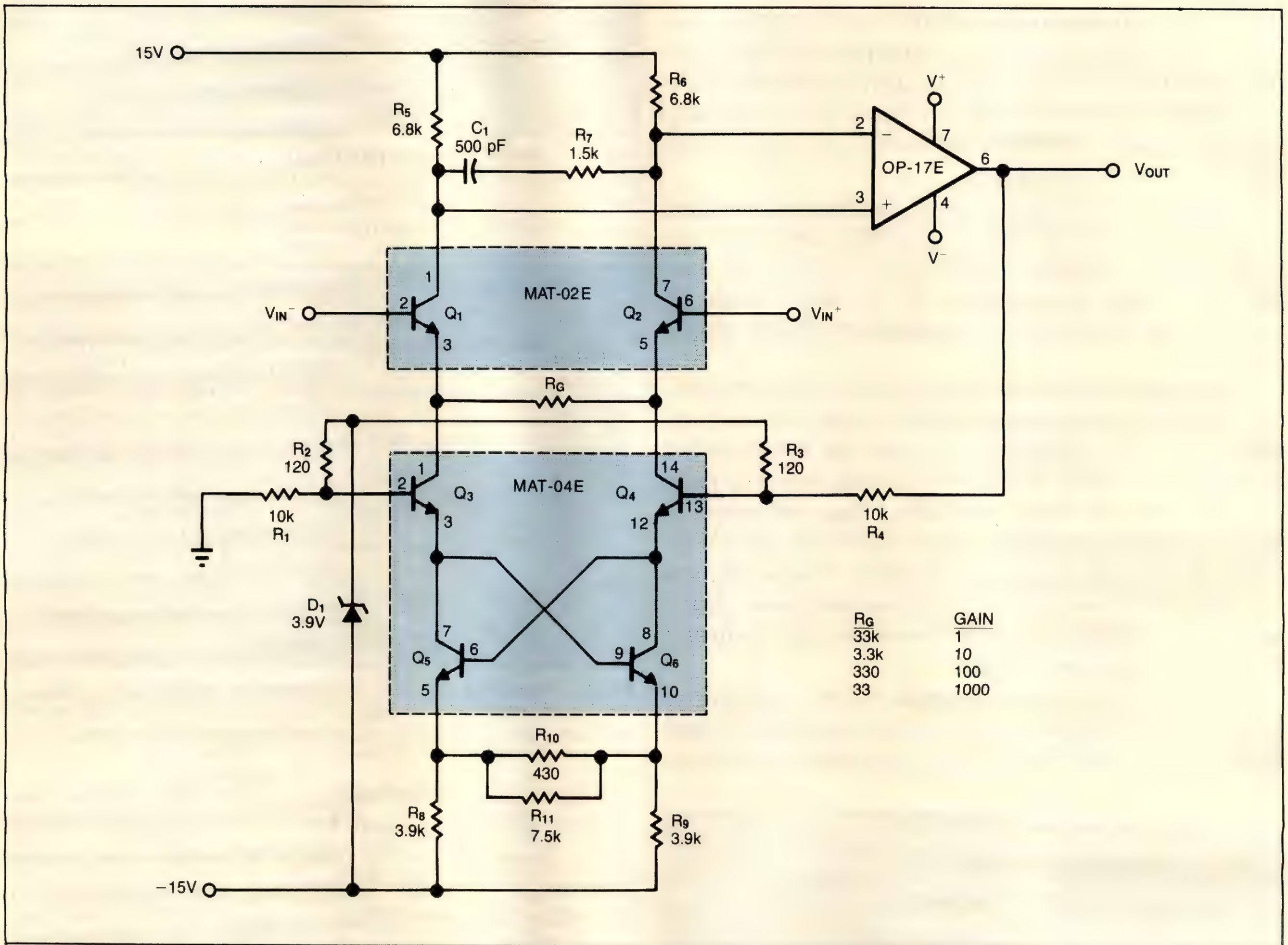
*Fig 2—**In this classic differential pair,** the total stage current (I) splits equally between the two transistors. The voltage-controlled attenuator of **Fig 1** does its job by producing an imbalance in the currents in the left and right sides of the pair.*

The resistors in the instrumentation amplifier are largely responsible for controlling the circuit's gain. For the resistor values shown in **Fig 5,** the instrumentation amplifier's gain (V_{OUT}/V_{IN}) is $33{,}000/R_G$. **Table 1** summarizes the performance of the amplifier. **Fig 6a** shows the input-referred spot noise over a 0- to 25-kHz bandwidth; the noise is flat at a level of approximately $1.2\ nV/\sqrt{Hz}$. **Fig 6b** shows the low-frequency noise spectrum. A notable feature of this spectrum is the low (2-Hz) 1/f noise corner.

In applications using low-output, low-impedance transducers (for example, strain gauges), amplifiers must exhibit low voltage noise in order to maintain a good signal-to-noise ratio. It's the low voltage noise of $1.2\ nV/\sqrt{Hz}$ that makes **Fig 5**'s instrumentation amplifier suitable for use in many low-impedance transducer applications.

In certain applications (for example, audio preampli-

The monolithic construction of a transistor array ensures tight parameter matching and near-perfect thermal coupling.



R_G	GAIN
33k	1
3.3k	10
330	100
33	1000

Fig 5—Very low noise and high speed *are the hallmarks of this instrumentation amplifier. The circuit uses the MAT-04 quad-transistor array in a linearized cross-quad configuration. The array serves as a voltage-to-current converter that provides feedback to the input stage.*

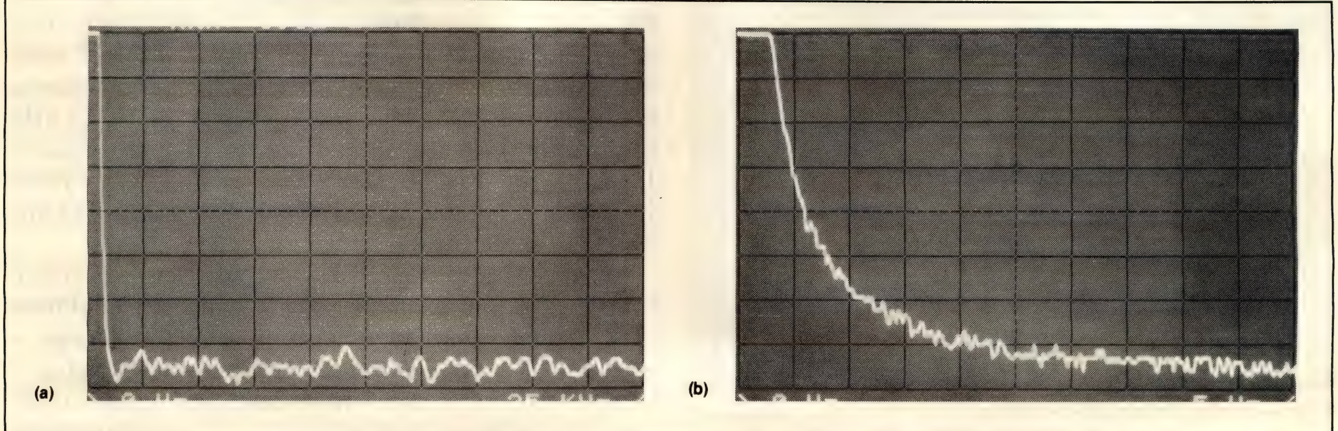


Fig 6—Low noise and a low noise corner *grace the instrumentation amplifier of* ***Fig 5****. Input-referred spot noise* ***(a)*** *is about 1.2 nV/$\sqrt{Hz}$. The noise corner* ***(b)*** *occurs at approximately 2 Hz.*

fication), dc-signal coupling is of no importance, but a low noise figure is essential. The ac-coupled preamplifier shown in **Fig 7** exhibits an input-referred noise-voltage density of only 900 pV/$\sqrt{Hz}$ at a gain of 200. The amplifier's low noise results from the use of a single-ended input stage that incorporates three transistors of a MAT-04 connected in parallel. This parallel-device technique lowers the transistors' effective base spreading resistance, thereby reducing thermal noise from this source by a factor of $\sqrt{3}$.

Tight matching of the three parallel transistors is a critical requirement. If the matching is poor, one transistor will steal most of the stage current, effectively removing the other two transistors from the circuit. In such a current-monopolizing situation, the noise reduction normally achieved by connecting the transistors in parallel would be lost. Note, by the way, that the circuit minimizes Schottky (shot) noise by using a relatively high stage current: 2 mA.

The fourth transistor of the MAT-04, Q_1, serves to bias the input stage. The OP-27 op amp forces the voltage drops across R_1 and R_2 to be equal, and it sets the bias current at 2 mA. Overall feedback for the preamplifier comes from resistors R_7 and R_8. The following equation describes the circuit's gain:

$$\frac{V_{OUT}}{V_{IN}} = \frac{R_8 + 5\Omega}{5\Omega}$$

The component values shown in **Fig 7** yield a preamplifier with a gain of 200. You might need to change compensation components R_3 and C_2 for other values of gain. The circuit's open-loop gain is greater than 10,000,000. **Fig 8** illustrates the large bandwidth of the preamplifier, and **Fig 9** shows the broadband noise spectrum (0 to 25 kHz). The spectrum is flat throughout the frequency band, and the noise, as noted, is approximately 900 pV/$\sqrt{Hz}$. The preamplifier's distortion, with an output of 10V p-p at 10 kHz, is less than 0.035%.

The circuits described thus far have very linear input/output transfer functions. Another application area in which precisely matched transistors are powerful tools is in the generation of nonlinear functions.

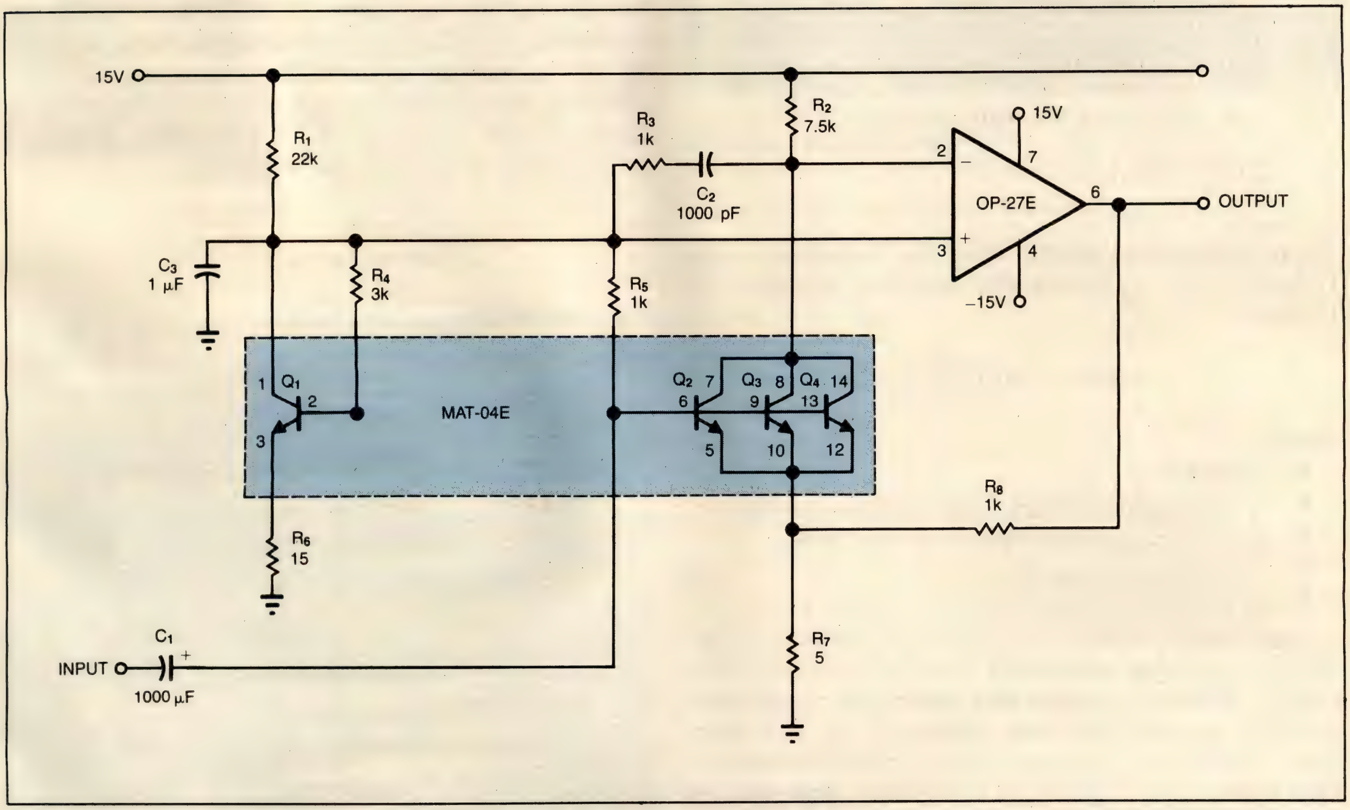


*Fig 7—**Low-noise ac amplification is the virtue** of this ac-coupled amplifier. The circuit achieves its low noise figure by using three transistors of a MAT-04 connected in parallel, thereby reducing thermal noise generated by the transistors' base spreading resistance.*

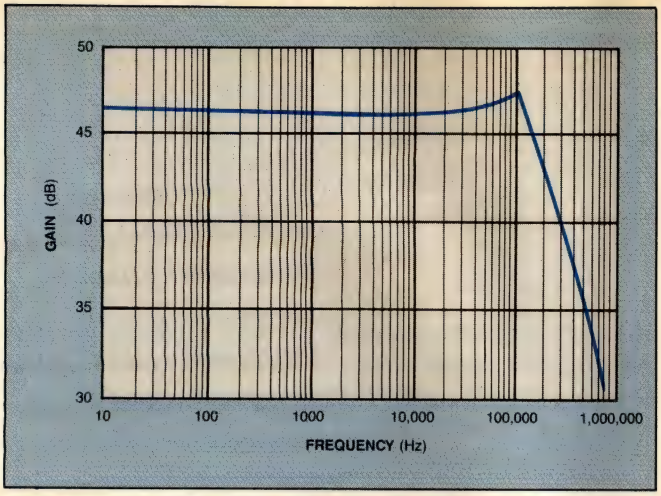


Fig 8—Easily meeting professional-audio requirements, *the ac preamplifier of* ***Fig 7*** *has a bandwidth greater than 100 kHz. This frequency-response plot is valid for the amplifier at a closed-loop gain of 200.*

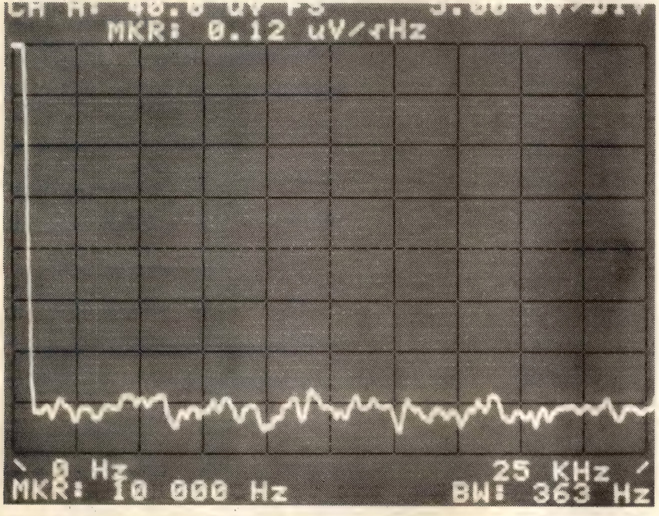


Fig 9—Low noise and a flat noise spectrum *are two welcome attributes of the ac preamplifier shown in* ***Fig 7****. This photo shows the noise spectrum from 0 to 25 kHz; the noise is approximately 900 pV/√Hz.*

These applications depend upon the transistor's logarithmic property, which the following equation expresses:

$$V_{BE} = V_T \ln\left(\frac{I_C}{I_S}\right),$$

where

- $V_T = kT/q$
- I_S=saturation current (approximately 10^{-15}A)
- k=Boltzmann's constant=1.38×10^{-23}J/°K
- T=temperature in °K
- q=electron charge=1.602×10^{-19} coul.

Logarithmic circuits are virtually impossible to implement by using unmatched transistors because they require stringent thermal and parameter matching to maintain accuracy (see **box,** "Quads fill log and linear roles"). Moreover, general-purpose transistors and arrays exhibit poor logarithmic conformity. The result is degraded accuracy in nonlinear circuits.

The circuit shown in **Fig 10** is a vector summer that exploits the MAT-04's close logarithmic conformity. The circuit adds and subtracts logarithmically scaled inputs to generate the transfer function

$$V_{OUT} = k\sqrt{V_A^2 + V_B^2},$$

where k is a circuit-dependent scale factor.

The circuit consists of two log amplifiers, each of which uses two transistors and an op amp. The voltage across transistors Q_1 and Q_2 is equal to the voltage across Q_3 and the base-emitter voltage of Q_4. The following equation expresses the result of summing the voltages in this loop:

$$V_{T1}\ln\left(\frac{I_1}{I_{S1}}\right) + V_{T2}\ln\left(\frac{I_2}{I_{S2}}\right) = V_{T3}\ln\left(\frac{I_A}{I_{S3}}\right) + V_{T4}\ln\left(\frac{I_{OUT}}{I_{S4}}\right).$$

Because all the transistors are precisely matched and at the same temperature, the I_S and V_T terms cancel:

$$2\ln I_1 = \ln I_A + \ln I_O = \ln(I_A I_O).$$

Eliminating the log terms on both sides yields the expression $I_1^2 = I_A I_O$. A similar analysis for transistors Q_4, Q_5, Q_6, and Q_7 produces the expression $I_2^2 = I_B I_O$. Summing the currents at the emitter of Q_4 gives an output current of $I_A + I_B$. If you solve these equations for I_A and I_B, you obtain the expression

$$I_O = \frac{I_1^2}{I_O} + \frac{I_2^2}{I_O} = \sqrt{I_1^2 + I_2^2}.$$

Op amp IC_3 forms a current-to-voltage converter that produces an output voltage equal to $I_O R_2$, so substitut-

TABLE 1—
INSTRUMENTATION-AMPLIFIER SPECS

PARAMETER	GAIN	PERFORMANCE
INPUT-REFERRED NOISE-VOLTAGE DENSITY	1000 100 10	1.2 nV/√Hz 36 nV/√Hz 3.0 nV/√Hz
BANDWIDTH	500 100 10	400 kHz 1 MHz 1.2 MHz
SLEW RATE	10	40V/μSEC
COMMON-MODE REJECTION	1000	130 dB
DISTORTION 20 Hz TO 20 kHz	100	0.03%
SETTLING TIME	1000	10 μSEC
POWER CONSUMPTION	ANY	350 mW

A vector summer exploits the quad-transistor array's close logarithmic conformity.

Quads fill log and linear roles

Designers of discrete circuits repeatedly run into the problem of component mismatches that compromise circuit performance. It's easy to reduce passive-component mismatching by using components with tighter tolerances, but active components present a more difficult problem. For example, discrete-transistor mismatching of beta and $V_{BE(ON)}$ can be poor even within the same transistor families.

Monolithic transistor arrays make an attempt at matching, but these arrays were traditionally designed to save board space rather than provide accurate parameter matching. The MAT-04 quad-transistor array **(Fig A)** follows in the footsteps of the MAT-01 and -02 matched dual transistors, and it provides very close parameter matching for applications requiring more than two transistors.

The MAT-04's layout and process techniques ensure that the offset voltage between any two transistors in the device does not exceed 200 μV, and beta mismatch does not exceed 2%—valuable attributes for linear-circuit design. In addition, the transistors are designed for high beta (400 min), 40V min breakdown, and 0.4Ω bulk resistance. Note that diodes protect the base-emitter junctions against reverse-voltage zener breakdown, thereby preventing degradation of beta and matching characteristics.

The substrate pins (V^-) are internally connected; you should connect one of these pins to the system's negative rail. You must limit current between the two V^- pins to 30 mA. In many applications, you can leave the substrate pins unconnected without causing any problems in the circuit.

The accuracy of nonlinear circuits depends on the logarithmic conformity of the transistors in the circuits. Extrinsic resistances and the Early effect produce deviations from the ideal logarithmic transistor relationship. *(Ed Note: The Early effect is the dependence of the emitter's characteristics on V_{CB} due to the variation in the collector depletion width with respect to V_{CB}.)* For small values of V_{CB}, you can combine these two effects to form an effective bulk resistance (r_{BE}). The transistor's logarithmic relationship

$$V_{BE} = V_T \ln\left(\frac{I_C}{I_S}\right)$$

changes to

$$V_{BE} = V_T \ln\left(\frac{I_C}{I_S}\right) + I_C r_{BE}.$$

An obvious way to reduce r_{BE}-induced error in nonlinear circuits is to reduce the maximum collector currents. If you do so, however, the op amp's offsets and leakage currents will become a limiting factor at low input levels.

Another way to avoid r_{BE}-induced errors is to use transistors that are specifically designed for low r_{BE}. The MAT-04's r_{BE} is 0.4Ω, a value that virtually eliminates r_{BE}-induced error in nonlinear circuits.

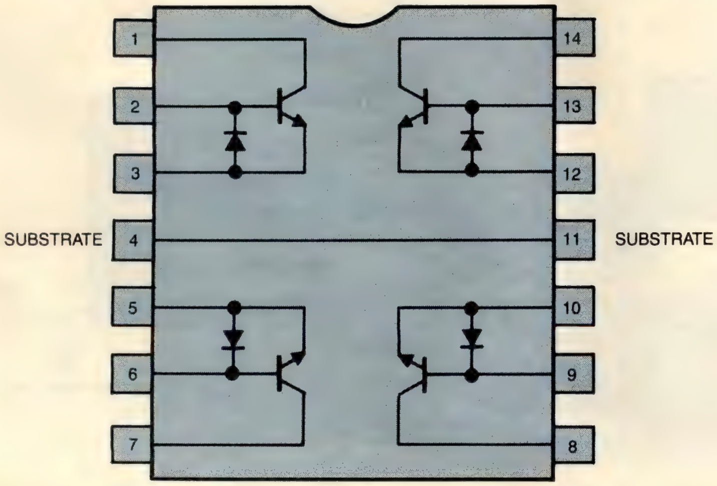


***Fig A—Close parameter matching and low bulk resistance** are the benefits offered by the MAT-04 quad-transistor array. Offset-voltage and beta matching are within 200 μV and 2%, respectively; the bulk resistance is 0.4Ω.*

ing for I_O, I_1, and I_2 in the above equation leads to

$$V_{OUT} = R_2\sqrt{\left(\frac{V_A}{R_1}\right)^2 + \left(\frac{V_B}{R_3}\right)^2}.$$

In the circuit of **Fig 10,** $R_1=R_3$ and $R_2=R_1/\sqrt{2}$, so

$$V_{OUT} = \frac{1}{\sqrt{2}}\sqrt{V_A^2 + V_B^2}.$$

Using a value of $R_1/\sqrt{2}$ produces a scale factor of $1/\sqrt{2}$; you can thus apply 10V to both inputs simultaneously without incurring the danger that V_{OUT} will exceed the output range of op amp IC_3. The built-in protection diodes in the MAT-04 allow you to apply negative input voltages without damaging the MAT-04. Under this condition, the output voltage is 0V.

You should mount the two MAT-04 arrays close to each other in the circuit. The close mounting reduces errors that could arise through temperature differences between the two matched quad transistors. Partitioning the two MAT-04 units as shown in **Fig 10** minimizes errors attributable to inherent mismatches and temperature differences between the two matched quad transistors. The accuracy of the vector summer is better than 0.5% over the input range of 10 mV to 10V.

You can exploit the MAT-04's logarithmic conformity in other nonlinear circuits. Consider, for example, the squaring and square-root circuits in **Figs 11a and 11b,** respectively. These circuits work in a fashion similar to the mode of operation of the vector summer. For example, summing the voltage loop for the squaring circuit across transistors Q_1, Q_2, Q_3, and Q_4 yields

$$V_T\ln\left(\frac{I_{IN}}{I_{S1}}\right) + V_{T2}\ln\left(\frac{I_{IN}}{I_{S2}}\right) = V_{T3}\ln\left(\frac{I_O}{I_{S3}}\right) + V_{T4}\ln\left(\frac{I_{REF}}{I_{S4}}\right).$$

Once again, all the transistors are precisely matched and at the same temperature, so the I_S and V_T terms cancel, giving

$$2\ln I_{IN} = \ln I_O + \ln I_{REF} = \ln(I_O I_{REF}).$$

This equation simplifies to $I_O=I_{IN}^2/I_{REF}$. Op amp IC_2 forms a current-to-voltage converter that produces an output voltage equal to R_2I_{OUT}. Substituting V_{IN}/R_1 for I_{IN} in the above equation yields

$$V_{OUT} = \frac{R_2}{I_{REF}}\left(\frac{V_{IN}}{R_1}\right)^2.$$

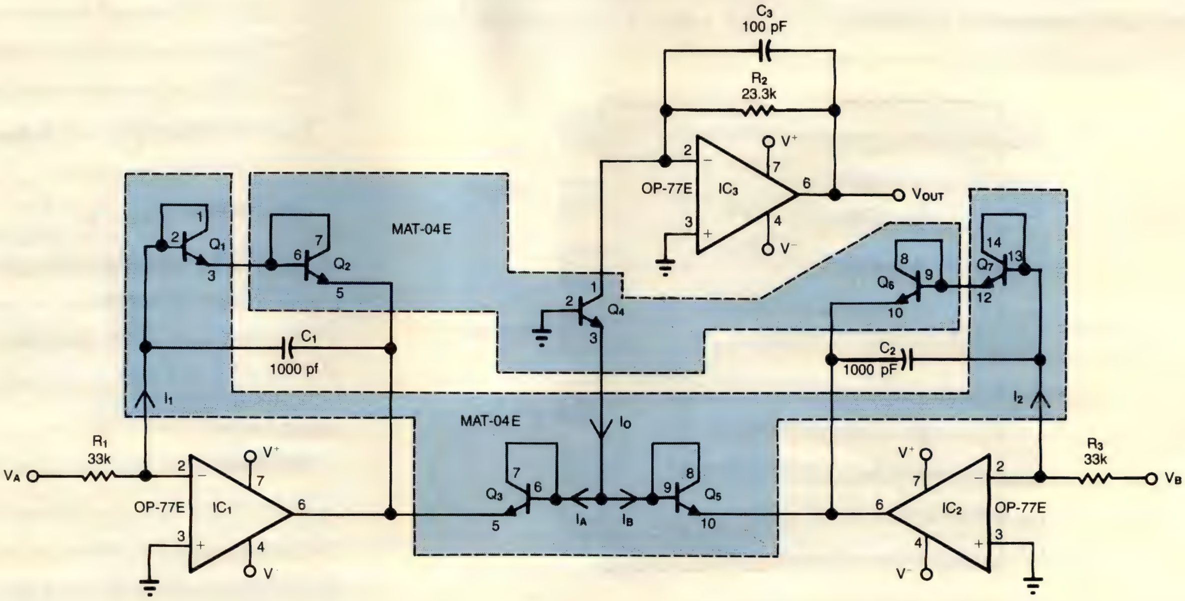


Fig 10—Close conformity to a logarithmic characteristic *on the part of the MAT-04's transistors makes this vector summer work. The circuit adds the log-scaled inputs to generate the square root of the sum of the squares of the inputs.*

Tight matching and tracking of betas and base-to-emitter voltages ensures equal current sharing in differential pairs.

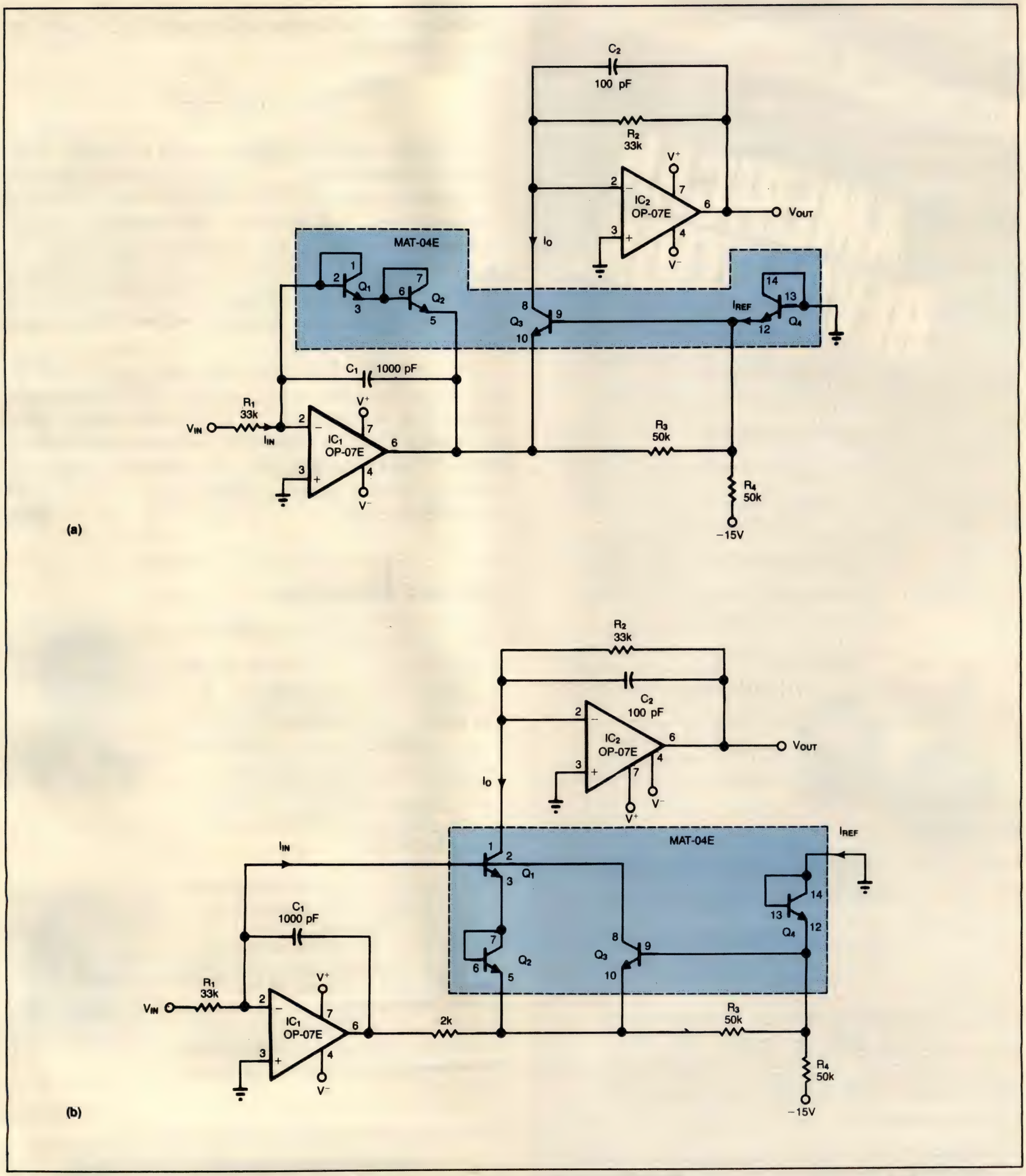


Fig 11—You can generate accurate squares and square roots *with these nonlinear circuits. The squaring circuit **(a)** specs 0.5% max accuracy for inputs of 100 mV to 10V. The square-root circuit **(b)** offers 0.1% accuracy for the same input range.*

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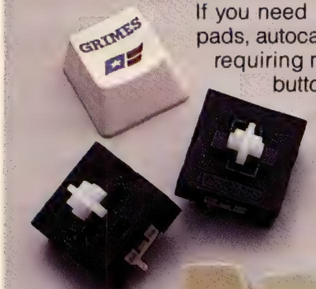

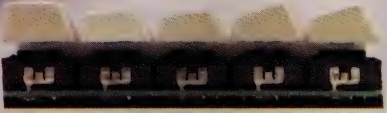

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A similar analysis for the square-root circuit yields its transfer function

$$V_{OUT} = R_2\sqrt{\frac{V_{IN}I_{REF}}{R_1}}.$$

In the two circuits of **Fig 11,** I_{REF} is a function of the negative power supply. To maintain accuracy, be sure the negative supply is well stabilized. For applications requiring very high accuracy, you can use a voltage reference to set I_{REF}. An important consideration to keep in mind for the squaring circuit is the fact that a sufficiently large input voltage can force the output to a level higher than the operating range of the output op amp.

You can adjust R_4 to scale I_{REF}, and you can trim R_1 and R_2 to keep the output voltage within the usable range. The accuracy of the square-root circuit after calibration is better than 0.1% over the input-voltage range of 100 mV to 10V. For the same input range, the accuracy of the squaring circuit after calibration is better than 0.5%. **EDN**

Authors' biographies

Art Kapoor is a product-marketing engineer at Precision Monolithics Inc (Santa Clara, CA). His duties include writing applications articles for new products. Holder of a BS degree (from the University of California at Berkeley) in electrical engineering and computer science, Art also earned an MBA at the University of Michigan. His spare-time activities include backpacking, skiing, and collecting old books and maps.

Derek Bowers is a fellow in new-product development at Precision Monolithics Inc. His duties include the design of linear ICs. Derek obtained a BS degree in physics and mathematics from Sheffield University in the UK. Seven years with PMI, he previously worked for Triad Computing Systems in London. He holds four patents, and he enjoys listening to music in his leisure time.

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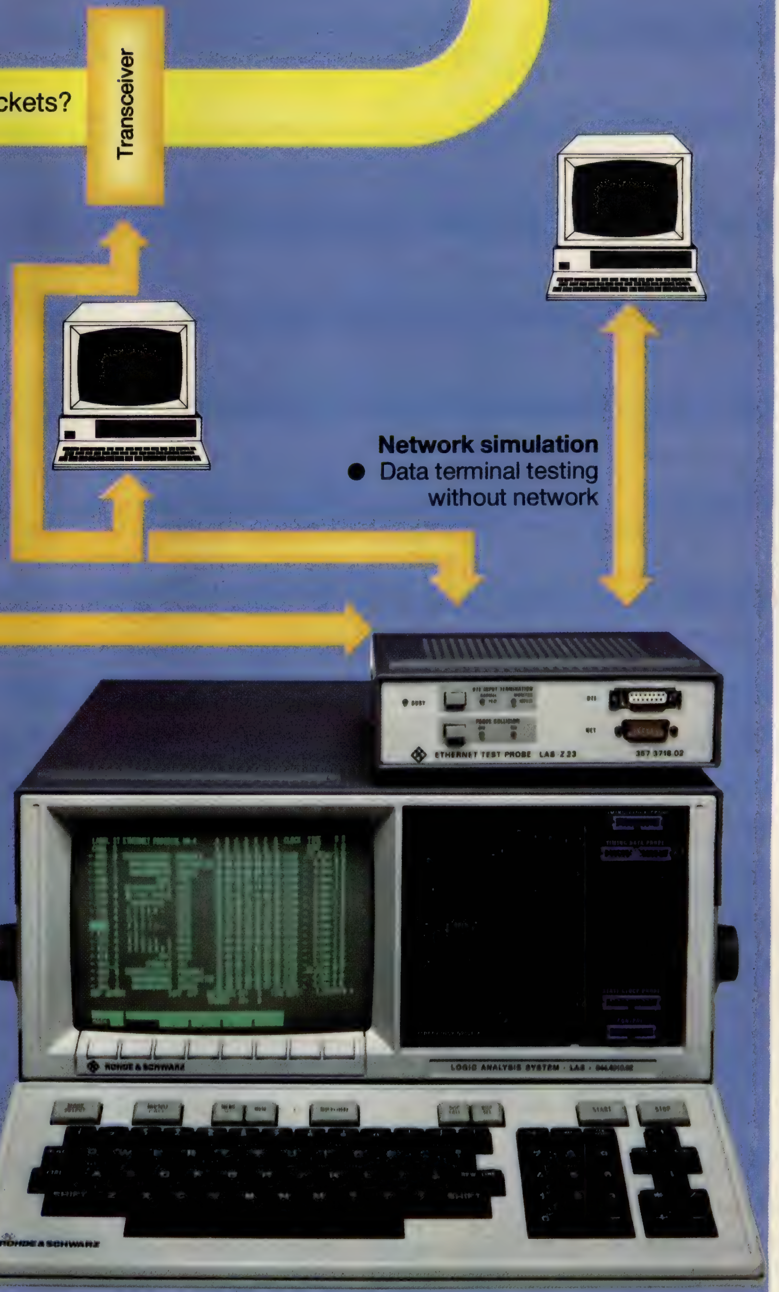

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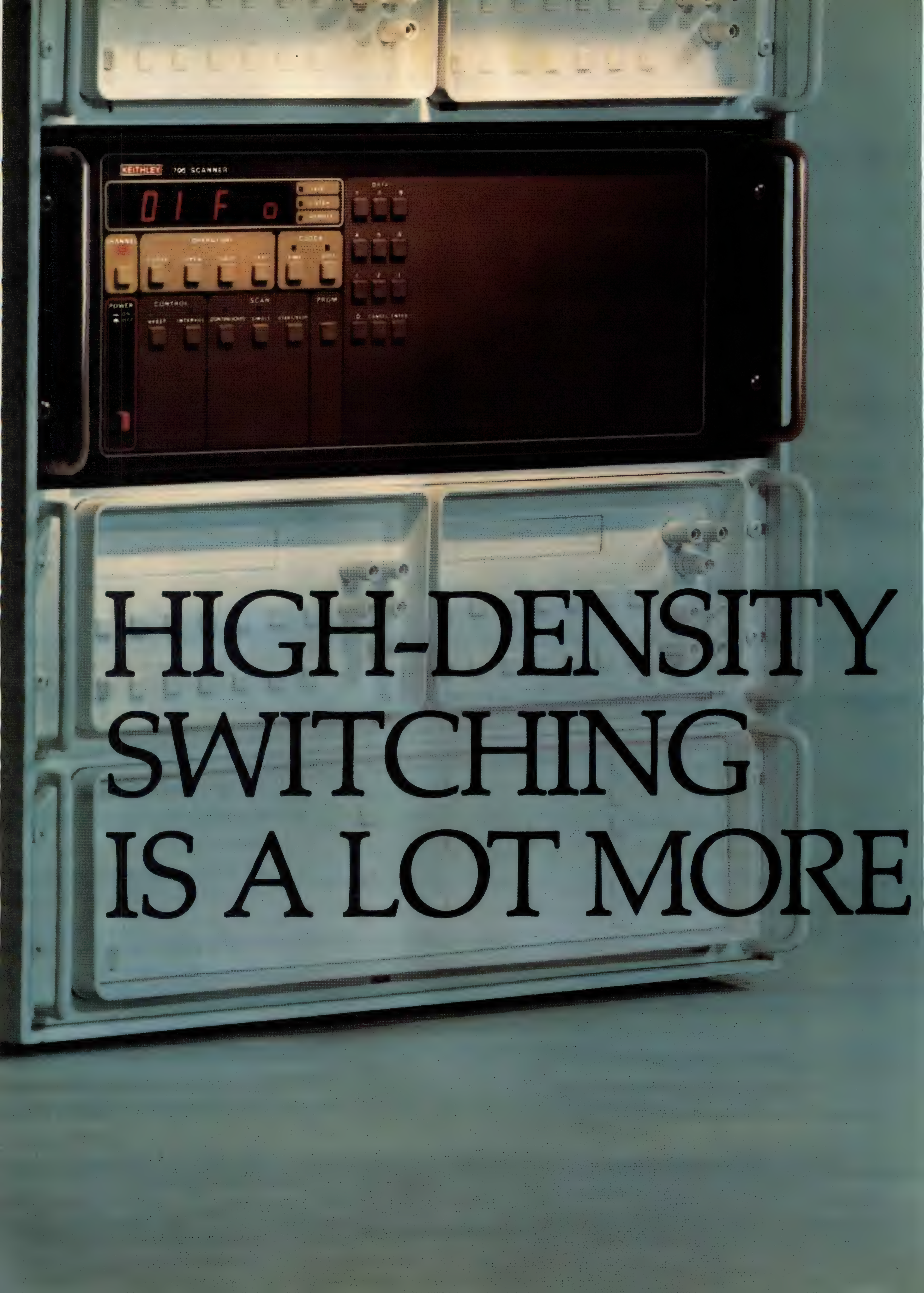
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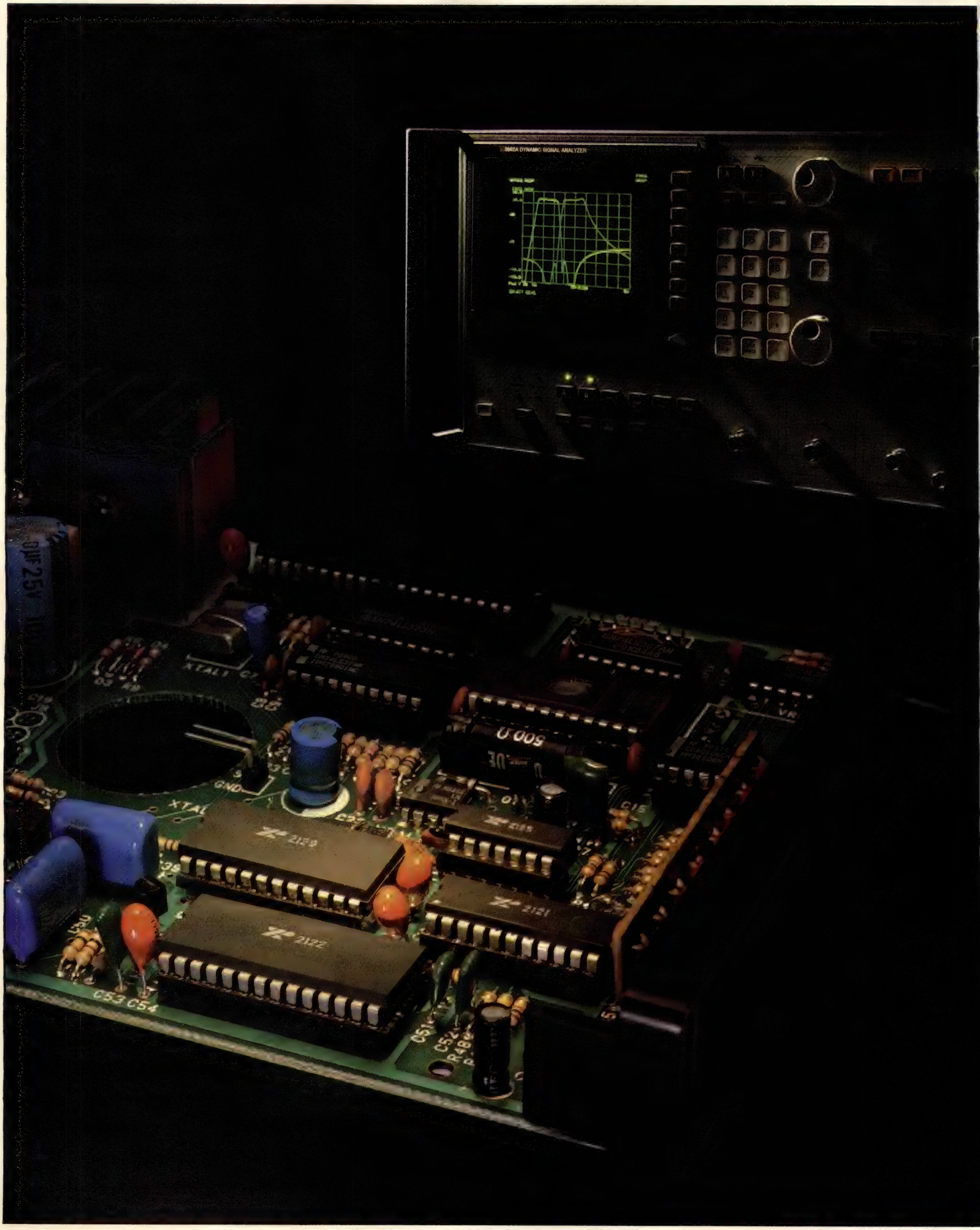

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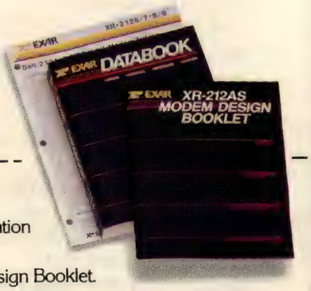

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CIRCLE NO 115

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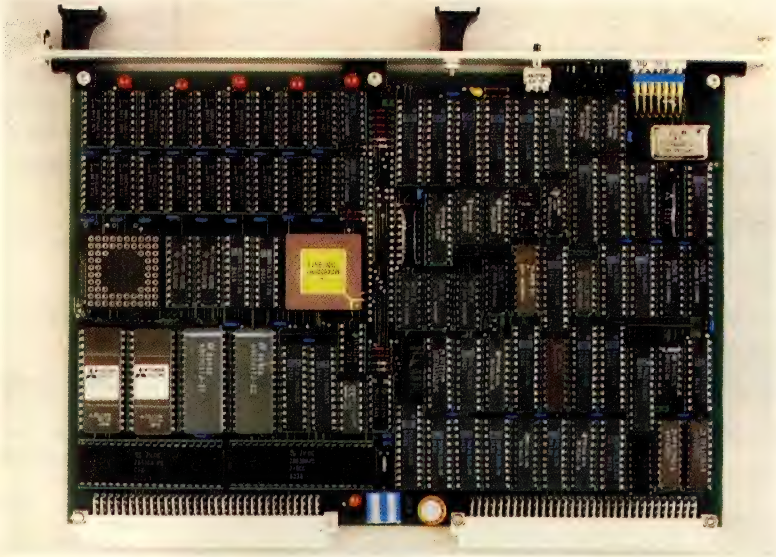

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CIRCLE NO 116

Connect terminals to your CPU over PBX telephone lines

Voice-digitizing ICs allow telephones and data terminals to share 2-wire access channels within a complex. You can use the ICs to build a voice/data modem that provides simultaneous voice and data transmissions while reducing your in-house cabling costs.

Steve Bramblett, *Motorola*

You can use pulse-code-modulation (PCM) techniques to build a simple, economical voice/data system that you can add to an in-house telephone network served by a private branch exchange (PBX). Based on one of several recently introduced voice-digitizing ICs, these modems let your existing 2-wire telephone extension cables simultaneously carry voice between your telephone and a PBX and digital data between your terminal and a host computer. The voice/data system consists of a PBX/CPU interface at one end of the line and a telset/terminal interface at the other end.

You can use analog or digital methods to implement a voice/data system. With the analog approach, you convert digital data to analog signals for transmission over the telephone line. Using the digital technique, you digitize voice signals before mixing them with computer data.

The analog approach has several drawbacks. First, if you use a standard voice-band modem, it pre-empts the line and prevents simultaneous conversation. Second, if you use one of the new data-over-voice modems, you may have problems with your telephone equipment. These modems allow simultaneous transmission of voice and data over a pair of wires, but they use frequencies well above 3400 Hz, the upper cutoff frequency of the public dial-up network voice band. Data-over-voice modems are complex and relatively expensive. In addition, no standards govern them, so you must use the same manufacturer's equipment at both ends of the link to ensure compatibility.

The digital approach is currently more promising than the analog approach, and it lets you choose among three types of voice digitization. One is PCM, a well-understood technique that gives acceptable voice quality with a data rate of approximately 64k bps. Using 8-bit resolution, you can achieve a dynamic range of more than 70 dB. ICs that implement PCM perform all the necessary antialias filtering, digitization, dedigitization, and recovery filtering. They are called codec (coder/decoder) chips, and are available from Motorola and other chip manufacturers.

The other two digital techniques are, in general, less economical and more complex than PCM. Continuously variable slope delta (CVSD) modulation provides acceptable voice quality at lower data rates than PCM does, but it requires more chips and is therefore more costly. In adaptive differential PCM (ADPCM), PCM

The digital approach to voice/data-system design is currently more promising than the analog approach, and it lets you choose among three types of voice digitization.

voice signals are compressed into a 16k- or 32k-bps digital bit stream. ADPCM provides better voice quality and/or higher throughput than PCM does, but again it requires chips in addition to those needed for voice-to-PCM conversion.

Thus, at this time, PCM is the best choice for implementing a system that provides shared voice and data access from one or more outposts to a central location in your complex. The system, however, doesn't provide for data access to the public switched network beyond your PBX. If you need access to the public network for data transmission, you may need a data-only PBX, which uses digital telephony techniques for switching digital data. However, most data-only PBXs interface directly to RS-232C channels, so by installing a system such as the one in **Fig 1**, you'll already have done a good deal of the work required for a data-switching installation.

Fig 1 shows a voice/data system that you can add to an in-house telephone network served by a PBX. You can build a PBX/CPU interface using nine ICs; the telset/terminal interface uses five ICs.

At the core of each voice/data modem in **Fig 1** is a Motorola Universal Digital Loop Transceiver (UDLT). The IC, which has a data throughput of 80k bps in each direction, provides three synchronous full-duplex channels. One channel has a data rate of 64k bps and carries voice converted to 8-bit words at a sampling rate of 8 kHz. The remaining two channels have 8k-bps data rates; one carries digital data, and the other carries ringing commands and hook-status information between the PBX and the telephone.

Components are functionally related

The PBX/CPU interface **(Fig 2)** presents three appearances: To the telephone system, it must appear as a standard telephone; to the computer, it must appear as a modem; and to the telset/terminal interface at the other end of the extension line, it must appear as a digital line card. The PBX/CPU interface contains four groups of functionally related components: the timing-generation circuits, the analog-loop interface, the digit-

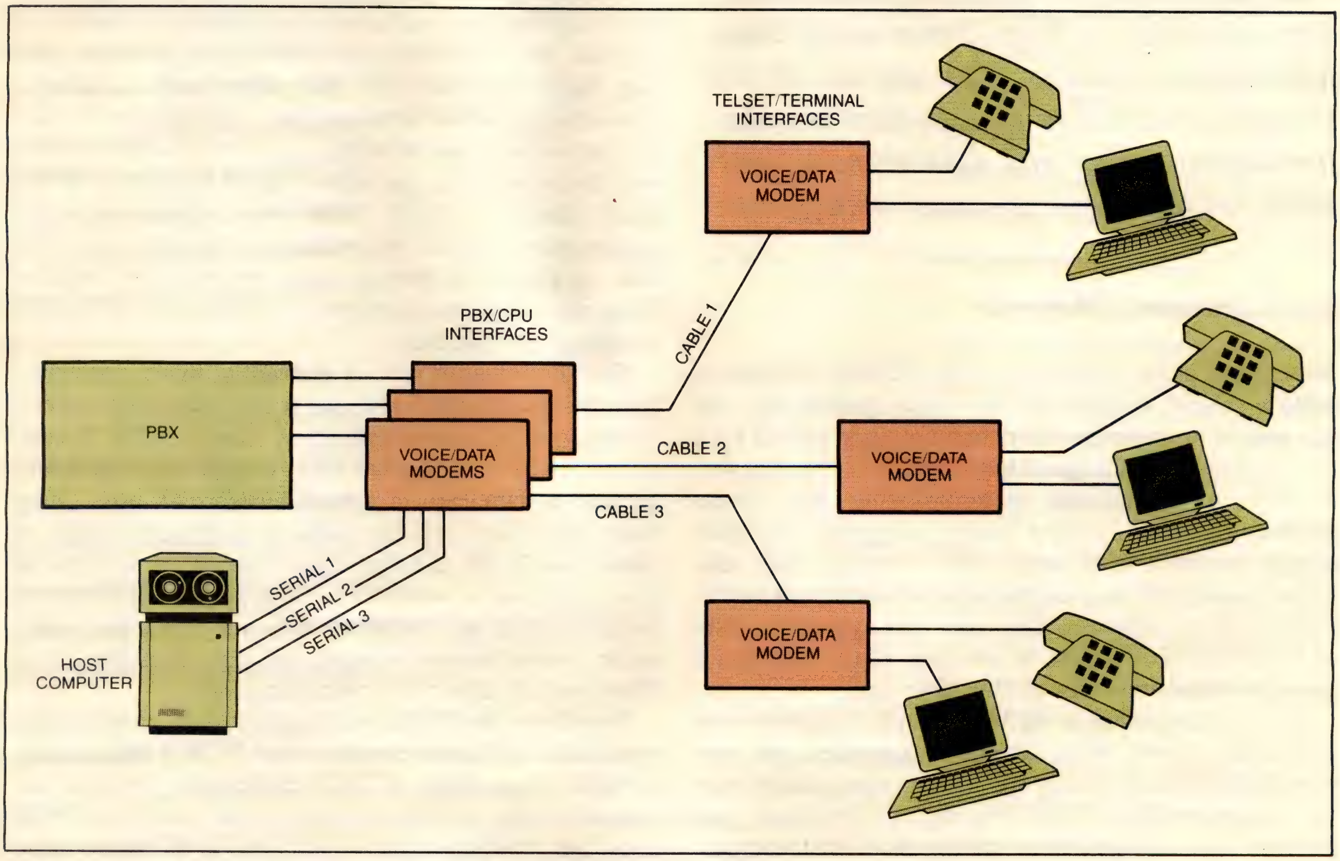


***Fig 1—Let your telephone network** carry digital data as well as voice. Install a simple voice/data modem on each extension line.*

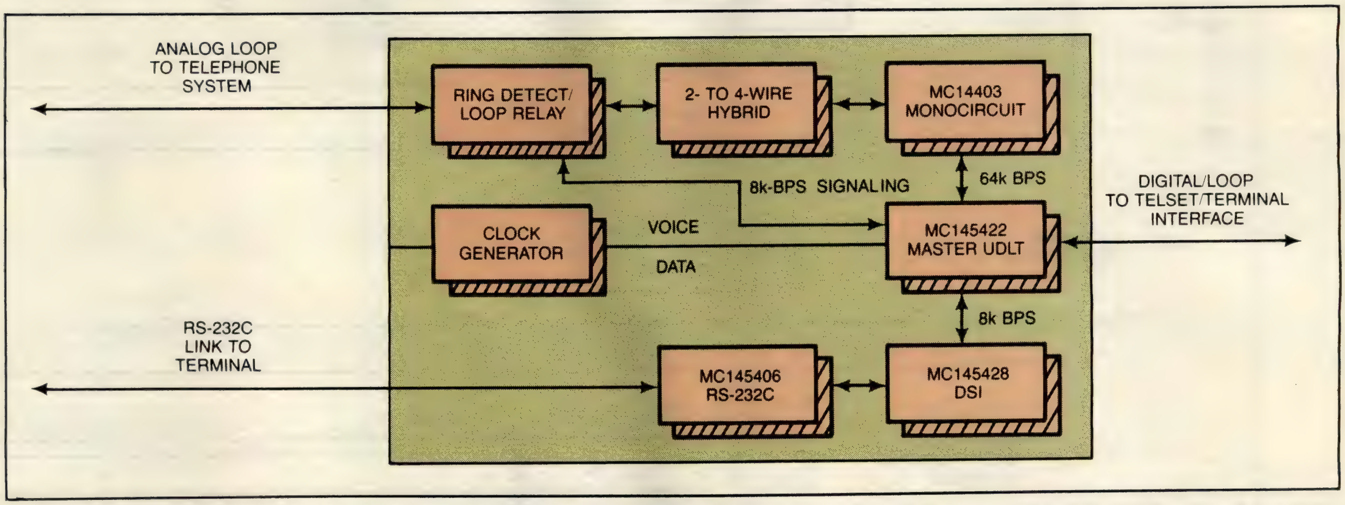


*Fig 2—**Four VLSI chips perform the major functions** of this voice/data modem. Add five standard support ICs at the PBX end and one at the remote end to complete the voice/data modem.*

al-data interface, and the digital-loop interface (**Fig 3**).

First, timing generation requires three ICs: a hexadecimal inverter, a dual 4-bit counter, and a dual D-type flip-flop. These devices generate a 4.096-MHz clock for IC_5, the data-set interface (DSI), and 2.048-MHz and 8-kHz clocks for the UDLT (IC_4) and the codec (IC_7), respectively.

The analog-loop interface, the second group of functionally related components, performs loop-control functions and ring detection, and it provides 2- to 4-wire conversion by means of the hybrid transformer. The SO_1 signal from the UDLT represents hook status, as signaled by the telephone via the telset/terminal interface. When the telephone is on-hook, the SO_1 signal is high, thereby causing transistor Q_1 to conduct and energize the relay. The relay switches the tip line into the ring-detection circuit (IC_9). Capacitors C_5 and C_6 block all dc signals, but they pass ac ringer signals from the PBX and, in conjunction with resistors R_6 through R_9, present the proper ac impedance to the line. A ringing signal received from the PBX is detected by IC_9 and converted to TTL-signal level by optoisolator IC_8. The output of the optoisolator is applied to the signaling channel input (SI_1) of the UDLT.

When the telephone goes off-hook, the relay contacts disconnect the ring detector and connect the tip line to hybrid transformer T_2; resistors R_6 and R_7, in series with the dc resistance of the transformer winding, then draw approximately 20 mA from the line to ensure an off-hook condition at the PBX. The off-hook condition turns off the PBX ringer if the telephone is answering a call; it seizes dialing circuitry if the telephone is initiating a call.

A 2-wire analog loop may (and often does) carry a composite signal representing speech originating at both ends of the line. At each end, a hybrid transformer and resistive network separate the signal and send incoming voice to the earpiece and outgoing voice to the line. Theoretically, the hybrid circuits could prevent any outgoing speech from reaching the local earpiece. In practice, however, total suppression of the side tone is neither possible (because the transformer creates phase shifts) nor desirable (because the sender, not hearing his own voice through the earpiece, would tend to shout or believe that the circuit was not working). Hybrid transformer T_2 and resistive network R_{12} through R_{16} separate the incoming and outgoing voice signals between the PBX and the codec, which digitizes and recovers voice signals.

The third group of functionally related components is the digital-data interface. All of the data streams handled by the UDLT chip are synchronous and have a nonstandard data rate. If you have access to the terminal and computer circuitry, you could install communications chips such as the Motorola 6850 asynchronous communications interface adapter (ACIA) or the Intel 8251, which can handle synchronous communications and can be clocked at 8k bps. These could interface to the UDLT via RS-232C driver and receiver ICs.

It's more practical, however, to include a synchronous/asynchronous-conversion interface in the voice/data modem so that both the computer and the terminal can use their standard communications hardware at

Text continues on pg 245

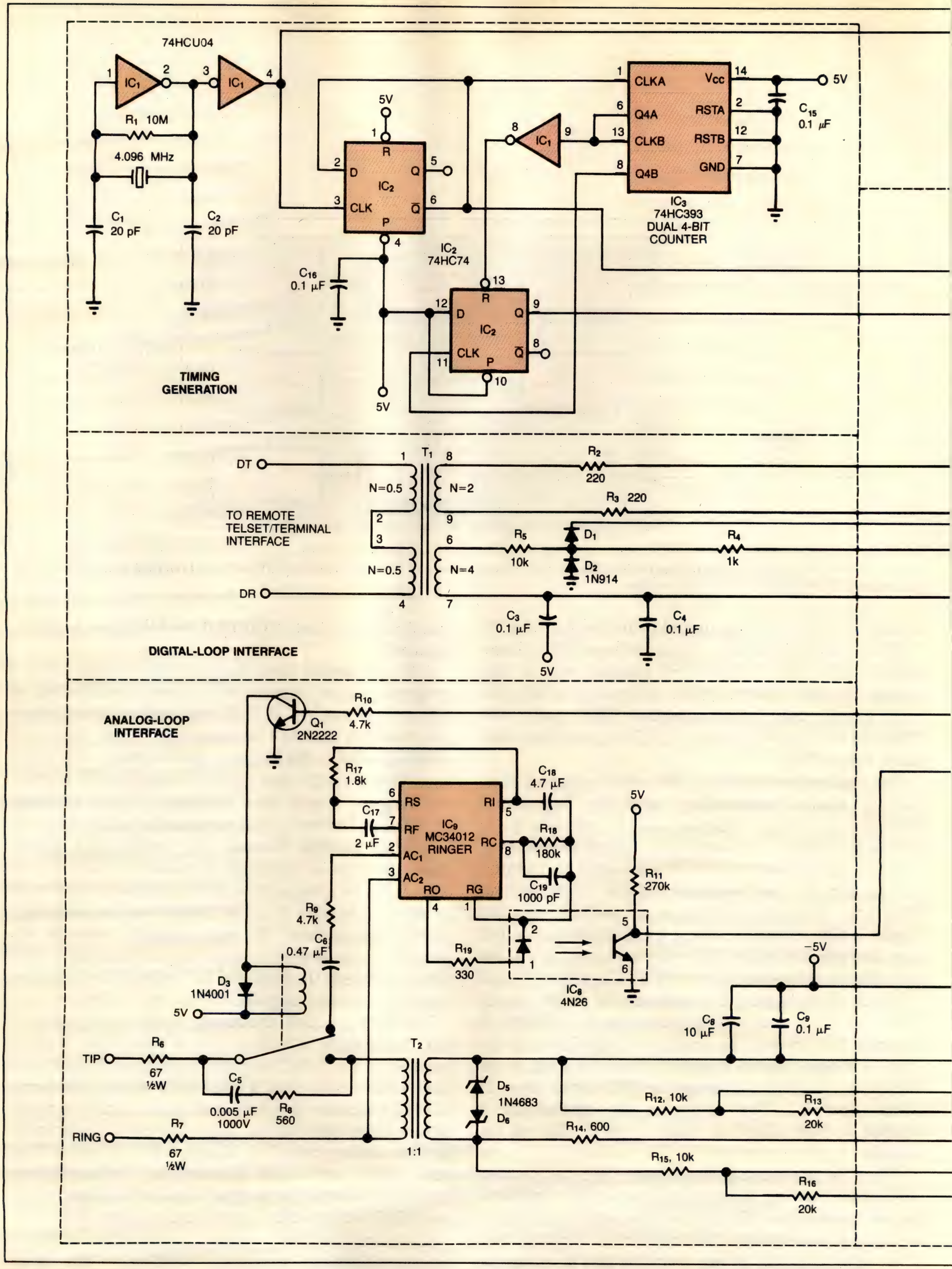
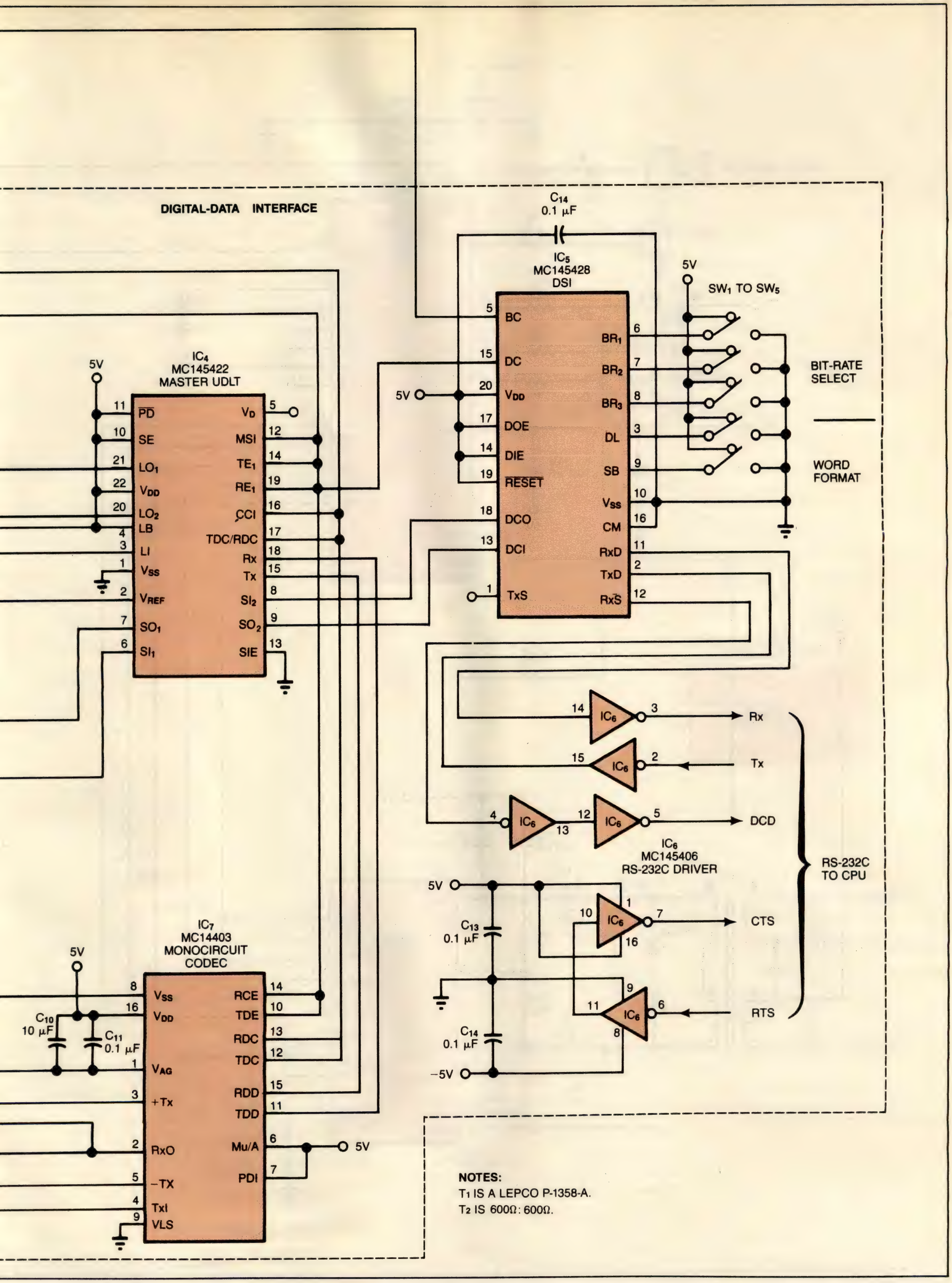


***Fig 3—This PBX/CPU interface appears as a modem** to the CPU and as a phone to the PBX. Via switches, you can select the RS-232C bit rate and word format.*



NOTES:
T1 IS A LEPCO P-1358-A.
T2 IS 600Ω: 600Ω.

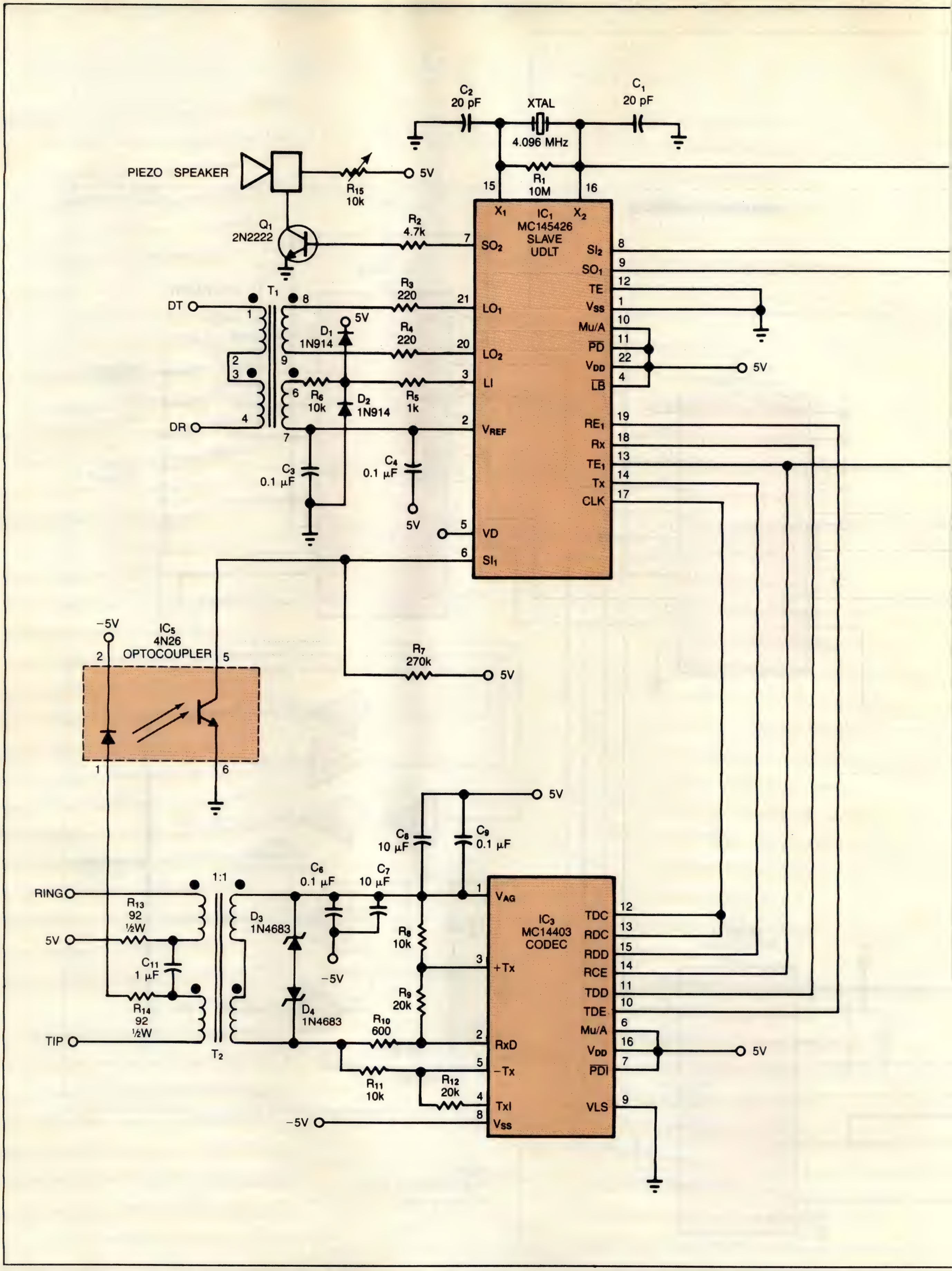
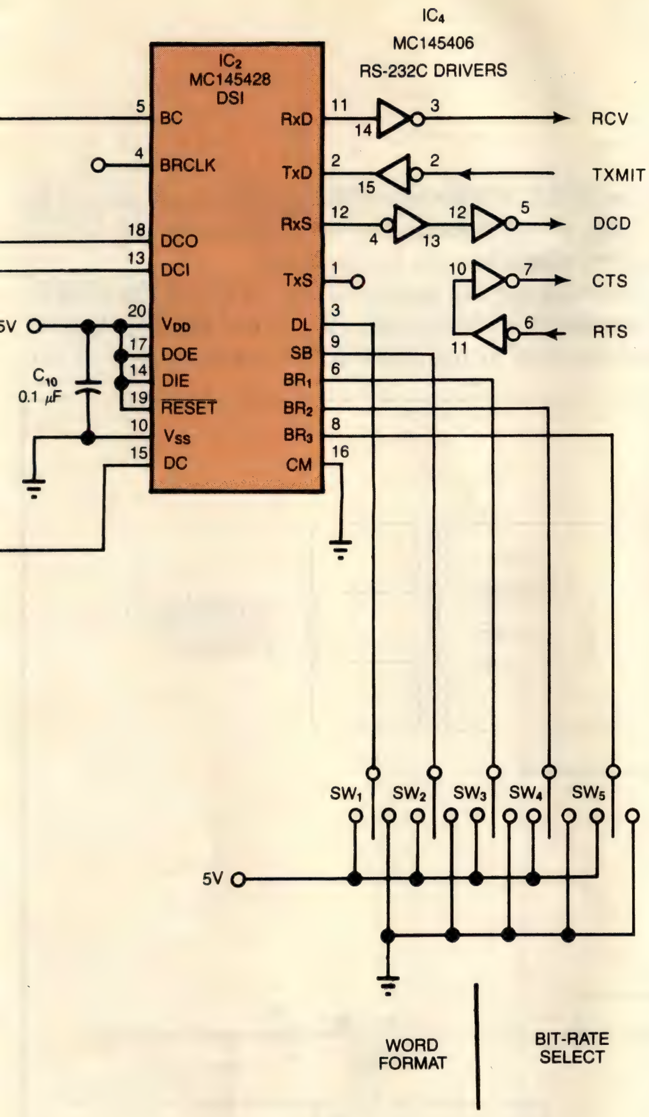


Fig 4—This telset/terminal interface appears as a modem to the terminal and as a line card to the phone. Hook-status and ring signals are passed over a separate digital signaling channel.



PCM gives acceptable voice quality at a data rate of 64k bps. With 8-bit words you can achieve a dynamic range greater than 70 dB.

9600 bps. You can use the same converter (a Motorola MC145428 DSI) in both the PBX/CPU interface and the telset/terminal interface. The DSI chip provides full-duplex conversion between asynchronous non-return-to-zero (NRZ) data and a synchronous, bit-oriented protocol optimized for ASCII data. To operate with an RS-232C terminal or computer port, the only other chips you'll need are TTL/RS-232C drivers and receivers. These are available in the Motorola MC145406 and similar ICs.

DSI performs sync/async conversion

The DSI performs all the conversion functions required to link the 8k-bps synchronous data channel of the UDLT to a standard RS-232C 9600-bps asynchronous channel. The 8-kHz synchronization signal applied to the MSI pin of the UDLT clocks terminal data from the UDLT's SI_2 pin into the DSI's DCI input for conversion and transmission to the computer. The same sync signal also clocks computer data from the DSI's DCO pin into the UDLT's SI_2 input for transmission to the terminal.

Not all of the RS-232C signals are implemented. Most terminals treat the CTS (Clear To Send) signal as a static signal indicating the start and end of a transmission, so the terminals tend to respond rather slowly. The slow response could cause an overrun if the terminal can't respond to a change in CTS status within one character-transmission period. The DSI send and receive channels each have a 4-word FIFO buffer; handshaking signal TxS goes low when the associated buffer contains more than two words; and the RxS signal goes low if the associated buffer fills up and then gets overwritten. The RxS signal also goes low if synchronization is lost on the synchronous channel.

The PBX/CPU interface uses the RxS signal to simulate the RS-232C DCD (Data Carrier Detect) control signal. To facilitate connection to RS-232C channels that require the CTS signal, you can interconnect one receiver and one driver so that the RTS signal from the terminal equipment automatically generates the CTS response signal. If you want the RS-232C channel to operate at more than 8k bps, you can generate a handshaking signal similar to CTS from the TxS signal; however, you must be sure that the terminal equipment stops sending within one, or at most two, character-transmission periods after the TxS signal goes low. If you don't observe this precaution, you'll lose data when the DSI FIFO buffer becomes full.

The final group of functionally related components in

For a simple and economical voice/data system, PCM is the best technique. VLSI ICs are available to implement all the required functions.

the PBX/CPU interface is the digital-loop interface, the link that provides digital communications over twisted-pair cable to the remote telset/terminal interface. The interface to the cable is a balanced differential-drive configuration. The typical line impedance is 110Ω; this impedance, reflected through transformer T_1, appears to the UDLT drivers as a 440Ω impedance. Resistors R_2 and R_3, which provide correct loading for the UDLT drivers, also maintain line balance.

Incoming signals appear at the LI pin of the UDLT. The resistor-diode network (R_4, R_5 and D_1, D_2) plays an essential role in maintaining the correct value of the

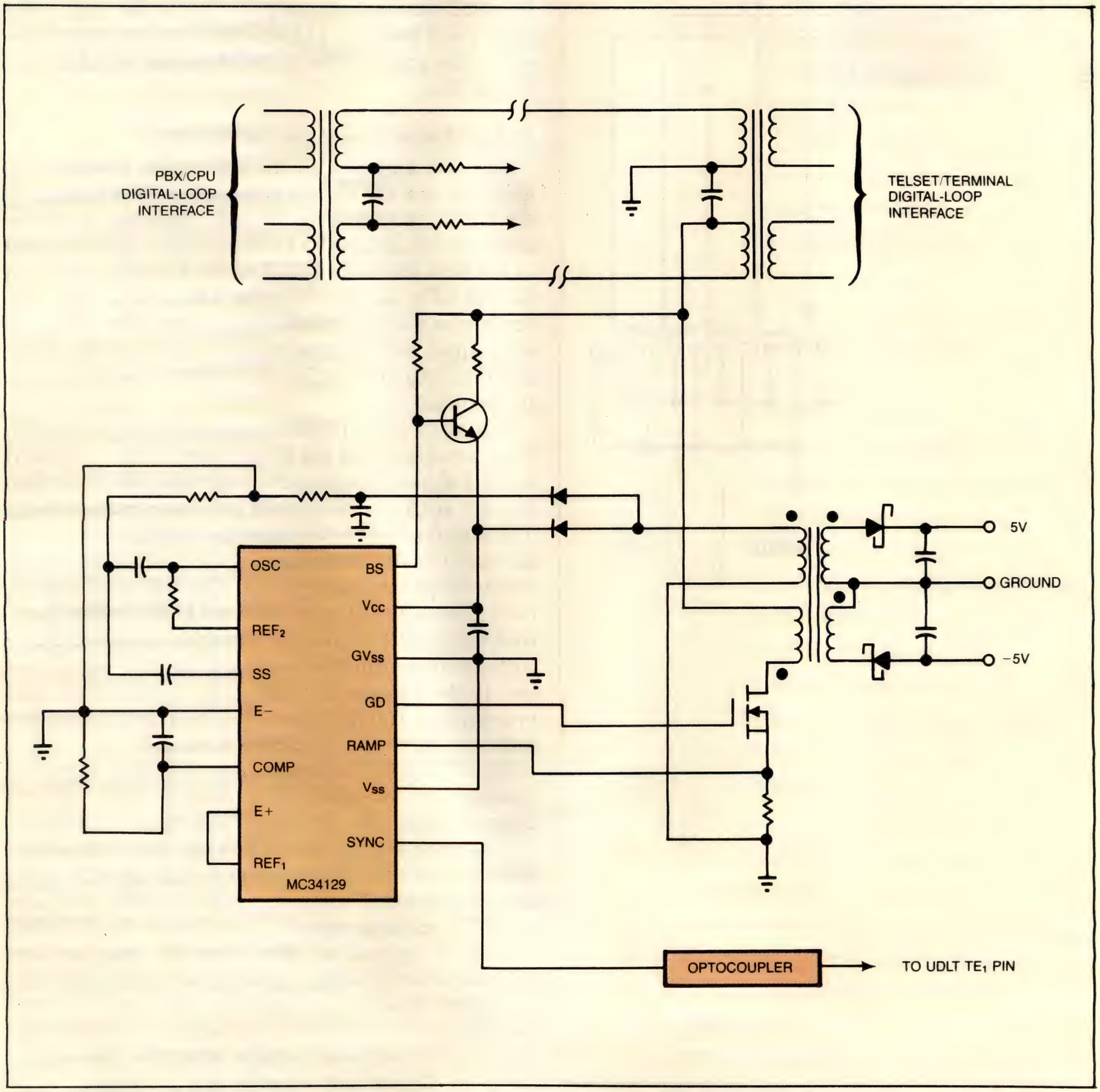


Fig 5—Supply battery power to the remote interface *via the telephone cable. Build this compact switching power supply on the remote interface to generate the required voltages.*

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The DSI IC can provide full-duplex conversion of asynchronous NRZ data from an RS-232C channel to a synchronous bit-oriented protocol optimized for ASCII data.

impedance presented to the line. If the signal at the LI terminal exceeds the power-supply voltage, the internal clamp diodes of the UDLT prevent receiver overload but now present a very low impedance at terminal LI.

Without the external resistor-diode network, this low impedance would have two undesirable effects. First, it would be translated by the transformer to an even lower impedance presented to the line, thus reducing the incoming signal level or possibly distorting it by clipping the peaks.

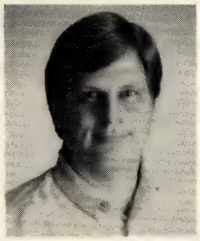
Second, when the UDLT transmits, the 1:2 turns ratio between the transformer's transmit and receive windings causes the voltage appearing across the receive winding to be double that of the transmit winding. Without the external resistor-diode network, the internal clamp diodes of the UDLT receiver would become conductors. The low impedance at pin LI would then appear even lower at the transmit winding and would load the transmit drivers so heavily that the signal reaching the line would be greatly attenuated and distorted, probably to the point of being indecipherable. Resistor R_5 ensures that, even if the signal across the receive winding is great enough to cause the clamping diodes to conduct, the impedance reflected to the transmit drivers will be high enough not to overload them.

The telset/terminal interface **(Fig 4)** provides functions that are complementary to those of the PBX/CPU interface, and it operates in much the same manner. In fact, the digital-data interface is similar to that of the PBX/CPU interface, both on the terminal side and on the digital-loop side. The main difference is that you use a slave UDLT (an MC145426) instead of a master UDLT. Timing generation is simple; the 4.096-MHz master oscillator resides on the slave UDLT, which provides the 8-kHz sync signal from pin TE_1 (instead of MSI). A 128-kHz clock for data transfers between the UDLT and the codec appears at the CLK pin of the UDLT.

The principal difference between the PBX/CPU interface and the telset/terminal interface is in the analog-loop circuits. In the telset/terminal interface, this circuit must provide battery voltage for the telephone set and sense loop current, rather than control loop current. Limiting resistors R_{13} and R_{14} provide two functions: They guarantee that a short circuit on the telephone line will not overload the power supply, and they provide the minimum 20-mA current for proper telephone operation. When the telephone goes off-hook, optocoupler IC_5 senses the current in the loop. The output of the optocoupler is applied to the SI_1 input of the UDLT for transmission (via the signaling channel) to the loop relay in the PBX/CPU interface. The output of the signaling channel (pin SO_2) triggers an external ringer; if you wish to use the ringer already built into the telephone, you'll have to add a relay and other circuitry.

Because the PBX/CPU interface must appear to the PBX as a telephone set, you can't draw power for the interface card from the telephone line. To provide the necessary ±5V for the PBX/CPU interface, you can split the windings of the digital loop and use the phone cable to carry dc to the remote interface card. You'd then need a small onboard synchronous switching power supply **(Fig 5)** at each telset/terminal interface. **EDN**

Author's biography



Steve Bramblett, now applications manager at Crystal Semiconductor Corp (Austin, TX), held a similar position at Motorola (Austin, TX) when he wrote this article. At Motorola for three years, he specialized in telecommunications applications. Steve holds a BSEE degree from Memphis State University, and in his spare time he enjoys music, softball, skiing, and experimenting with computers.

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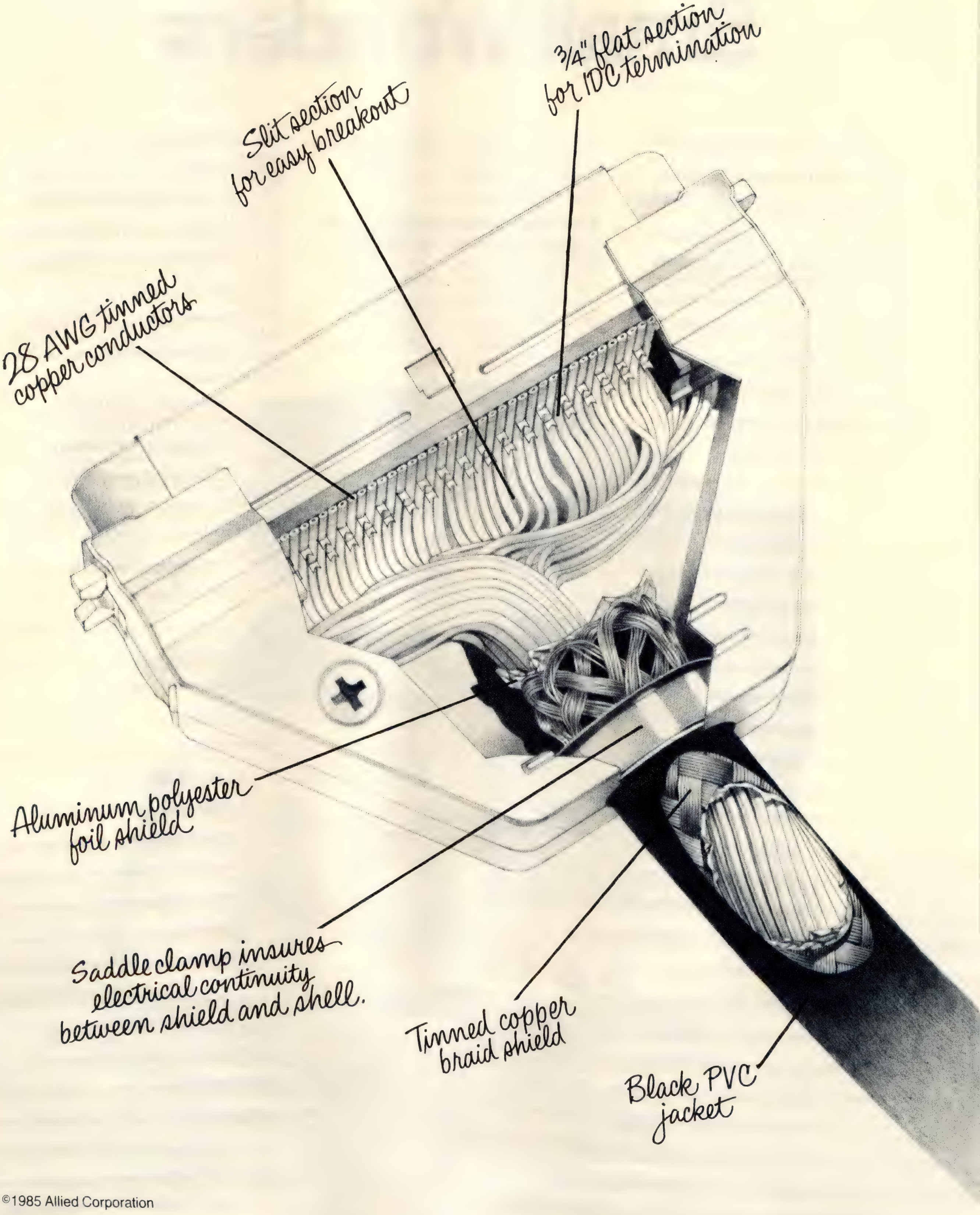

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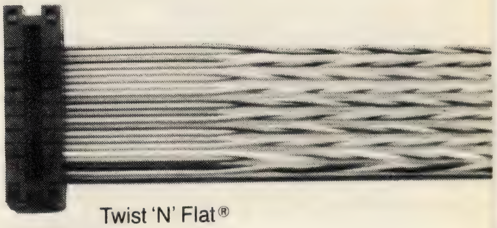

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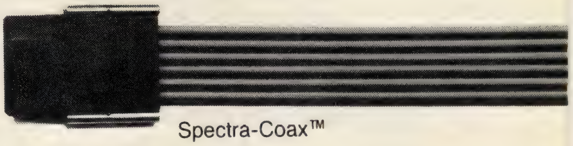

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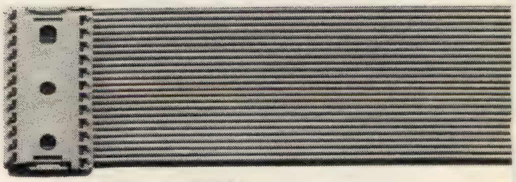

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CIRCLE NO 119

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APTER 4

The term "EMI" (electromagnetic interference) describes a form of pollution which degrades the ability of electronic equipment to function properly. In some cases, the impact of this pollution problem is merely annoyance – such as the ripples or snow on a TV screen caused by a nearby computer radiating electromagnetic signals. (Broadcasters intentionally radiate electromagnetic signals, but are licensed to do so as long as their signals are transmitted at frequencies assigned by the FCC.) In other cases, the result of EMI can be a matter of national security – such as the interception of sensitive data being transmitted electronically, or the failure of a critical military system.

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metaramics

HAPTER 3

amicon

ER 2

EMERSON & CUMING INC

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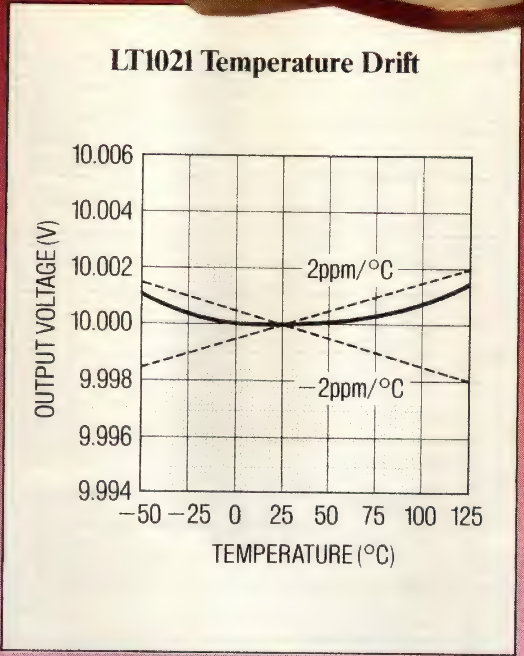
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CIRCLE NO 121

DESIGN IDEAS

EDITED BY TARLTON FLEMING

Standby clock takes over in 1 µsec

Paul Galluzzi
Dynamics Research Corp, Wilmington, MA

The circuit in **Fig 1** prevents interruption of a standard 1-MHz clock signal (clock A) by switching to a 1-MHz standby oscillator within one cycle (1 µsec). The loss-detect element is a D-type flip-flop (IC_5) whose D input samples clock A through a small pulse transformer. In normal operation, the constant phase relation between IC_5's D and CLK inputs is such that D is always sampled in a high state, so the Q output remains high. The Q output goes low, however, with the loss of clock A pulses from the T_1 secondary, which initiates a switch-over to clock B through the NAND gates IC_{1B}, IC_{1C}, and IC_{1D}.

For minimum disruption at changeover, clock B's oscillator should be synchronized to clock A as shown in **Fig 2**. Note that some modification may be necessary for frequencies other than 1 MHz to ensure the correct phase between IC_5's D and CLK inputs. **EDN**

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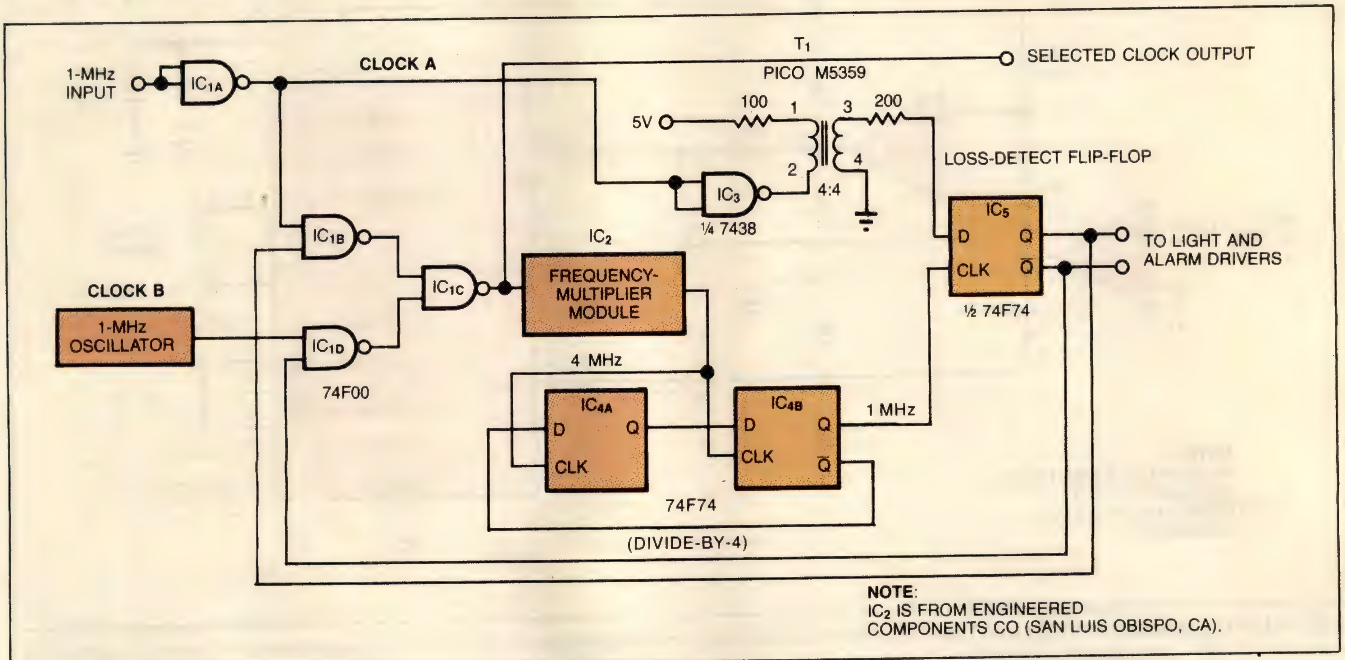
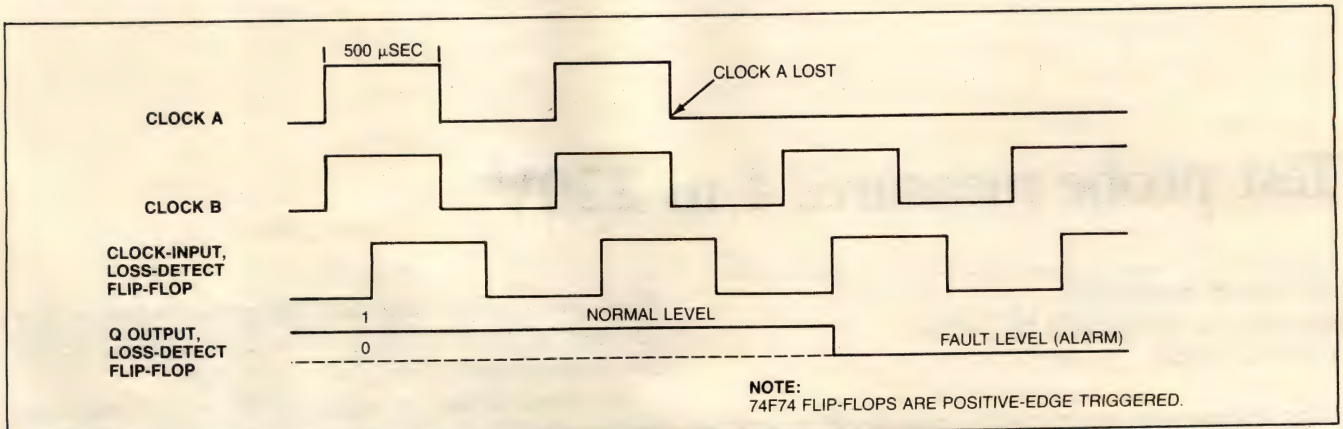


NOTE:
IC_2 IS FROM ENGINEERED COMPONENTS CO (SAN LUIS OBISPO, CA).

*Fig 1—**This circuit responds** to the loss of the clock A signal by switching to clock B within one clock cycle.*



NOTE:
74F74 FLIP-FLOPS ARE POSITIVE-EDGE TRIGGERED.

*Fig 2—**Outputs from the loss-detect flip-flop** trigger alarm circuits and initiate the switch-over from clock A to clock B.*

Variable reference extends converter's resolution

Leonard Sherman
National Semiconductor, Santa Clara, CA

You can increase an A/D converter's apparent resolution by deriving part of its reference voltage from the input signal. The resulting input/output relationship, however, is nonlinear. In **Fig 1**, the 8-bit converter's sensitivity is 5 mV (10-bit resolution) for small input signals, yet the input range is 5V.

The FET-input op amp IC_{1A} buffers the input signal; IC_{1B} sums the input with a fixed voltage (in this case, the 5V power supply). The result is a variable reference voltage for the converter, yielding the transfer function $D=(256\times4\times V_{IN})\div(3\times V_{IN}+5)$ for the voltage and resistor values shown. D is the digital-output code. Note that the ADC0820 will exhibit increased noise and nonlinearity for V_{REF} values of less than 1.25V. **EDN**

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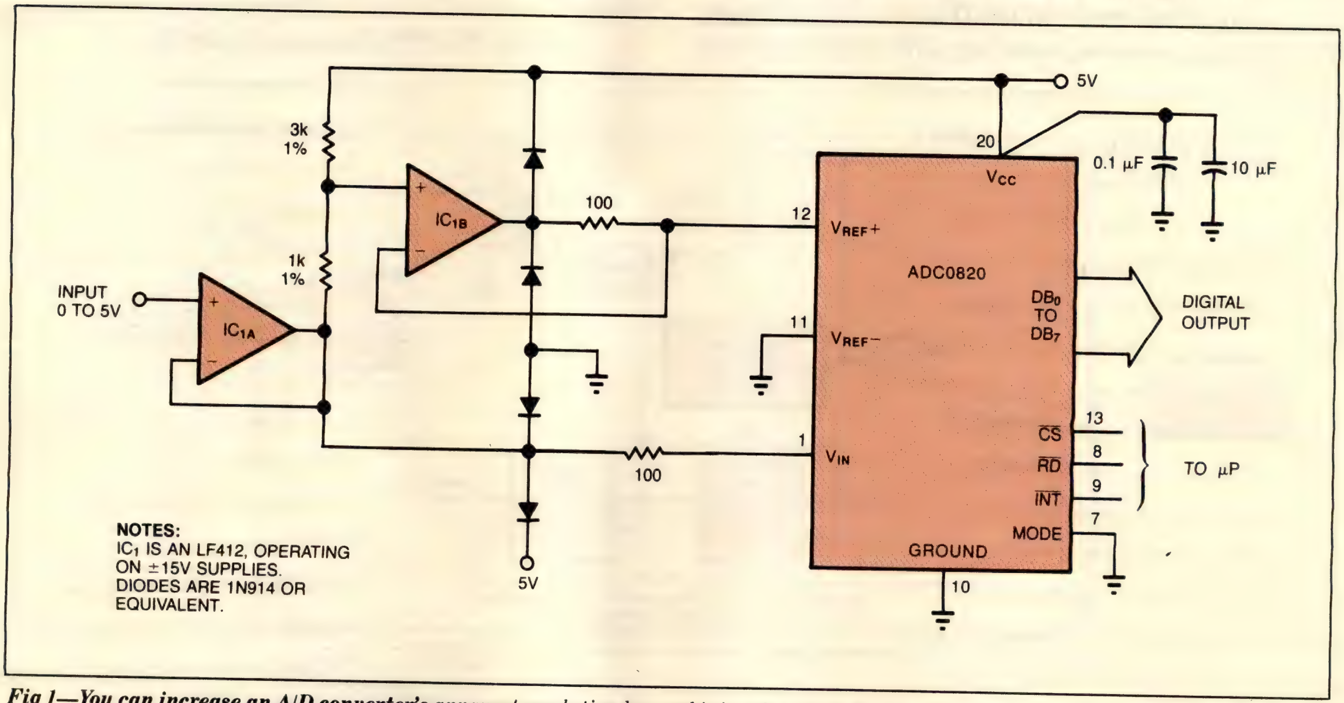


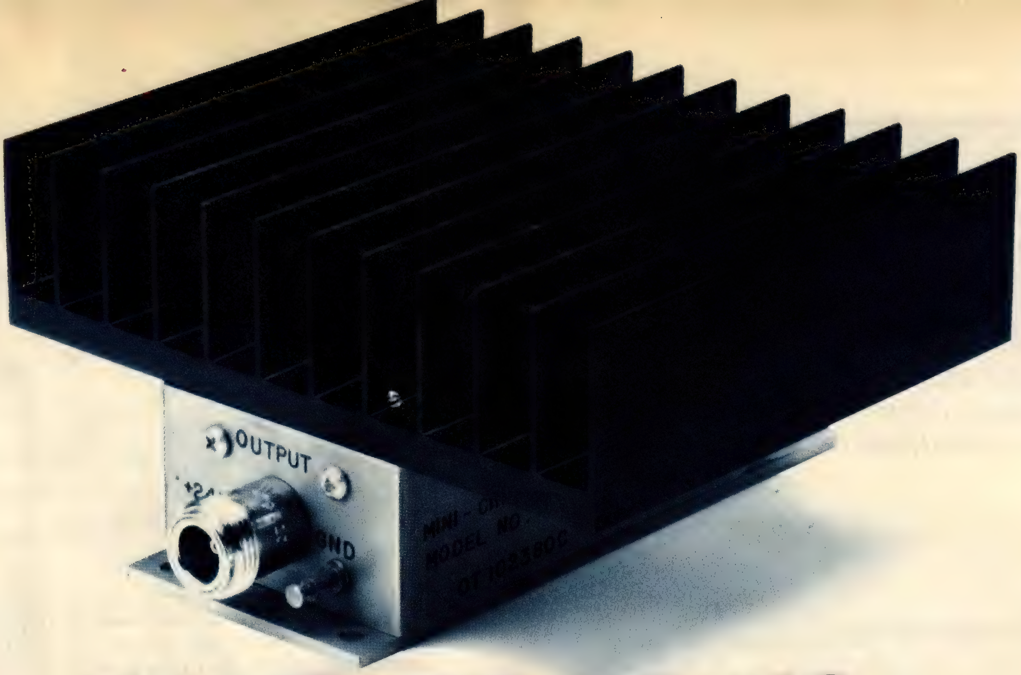
***Fig 1—You can increase an A/D converter's** apparent resolution by combining the input signal with a fixed reference voltage and feeding this sum to the converter's reference input.*

Test probe measures 4 to 220V

Christos S Koukourlis
Demokritos University of Thrace,
Xanthi, Greece

Using inexpensive components, you can fit a simple probe circuit (**Fig 1**) into a pencil-sized enclosure. When both LEDs are on, the probe indicates the presence of an ac voltage; either LED alone indicates the presence and polarity of a dc voltage.

The diode-bridge arrangement allows a 1-way current source (R_1, R_2, Q_1, and Q_2) to light either LED (or both) when the probe is activated by a test voltage.



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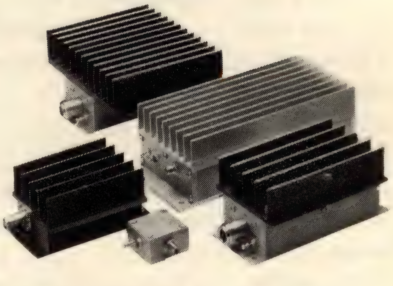

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ZHL-3A	0.4-150	24 Min.	±1.0 Max.	+29.5 dBm Min.	11 Typ.	+38 dBm	+24V	0.6A	199.00	(1-9)
ZHL-1A	2-500	16 Min.	±1.0 Max.	+28 dBm Min.	11 Typ.	+38 dBm	+24V	0.6A	199.00	(1-9)
ZHL-2	10-1000	15 Min.	±1.0 Max.	+29 dBm Min.	18 Typ.	+38 dBm	+24V	0.6A	349.00	(1-9)
ZHL-2-8	10-1000	27 Min.	±1.0 Max.	+29 dBm Min.	10 Typ.	+38 dBm	+24V	0.65A	474.00	(1-9)
ZHL-2-12	10-1200	24 Min.	±1.0 Max.	+29 dBm Min.	10 Typ.	+38 dBm	+24V	0.75A	599.00	(1-9)
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ZFL-2000	10-2000	20 Min.	±1.5 Max.	+17 dBm Min.	7 Typ.	+25 dBm	+15V	0.1A	179.00	(1-9)

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CIRCLE NO 122

Diodes in series with the LEDs provide the necessary peak-inverse voltage rating; the four diodes should each withstand 300V min. R_3 and C_1 provide a spike-suppression network to protect the current-source transistors when the probe is connected to a high voltage. *(Ed Note: The author recommends BF459 transistors. We substituted 2N3439 transistors (which are rated 350V min collector-emitter sustaining voltage) only for want of data on the BF459.)* **EDN**

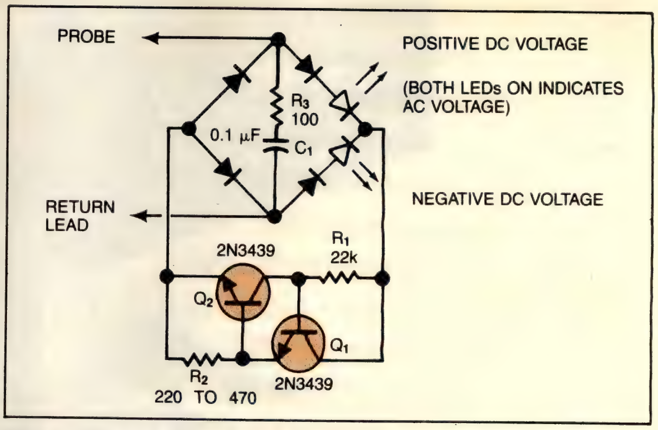

***Fig 1—This simple test probe indicates ac or dc voltage** over a 4 to 220V range. The current source (R_1, R_2, Q_1, and Q_2) ensures a constant current in the LEDs for any acceptable test voltage.*

To Vote For This Design, Circle No 749

Simple timer requires no A/D converter

James Knipfer
R-K Electric Co, Cincinnati, OH

A simple RC network can provide a µP with a software-programmable timer for nonprecision timing chores. In **Fig 1**, such a timer eliminates the need for more expensive dedicated ICs.

The 3.3-µF capacitor is charged through the diode and the 270Ω resistor when a logic 1 is asserted at the PB_0 output pin. By writing a logic 0 to that pin, you can then initiate the capacitor's discharge through the 3.3-kΩ resistor and 1-MΩ trimming potentiometer. The processor interrupts when the capacitor voltage reaches approximately ⅓ of the supply voltage. Your interrupt-service routine can count these interrupts, reset PB_0 each time, and make a decision accordingly. For example, the routine might repeatedly decrement a value stored in one memory location and cause the processor to take appropriate action when the value reaches 0. **EDN**

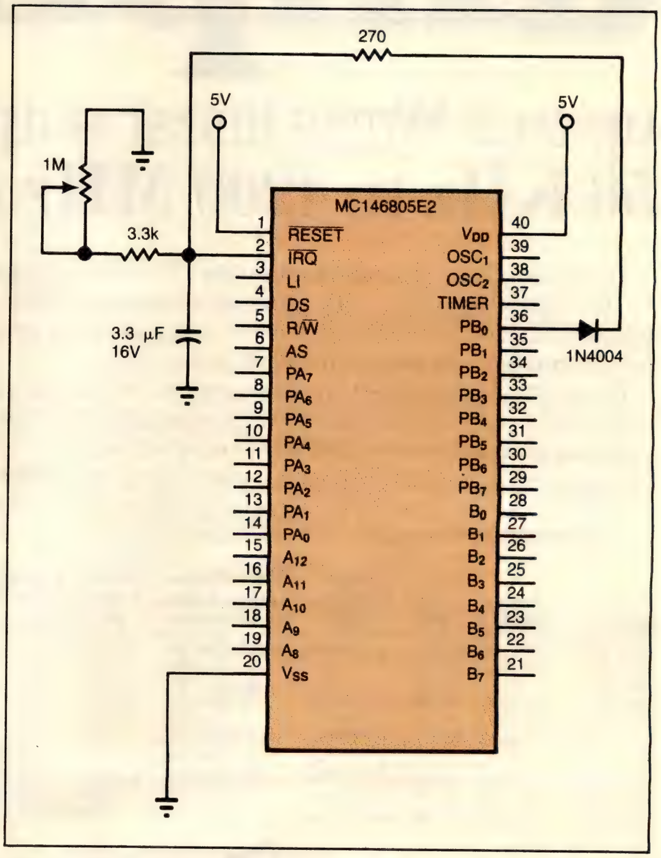

***Fig 1—This simple RC timer is software programmable.** By repeatedly writing 1 and then 0 to output PB_0 and allowing the capacitive discharge to interrupt the processor, you can generate arbitrary time intervals.*

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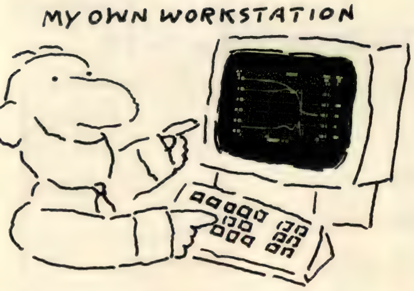
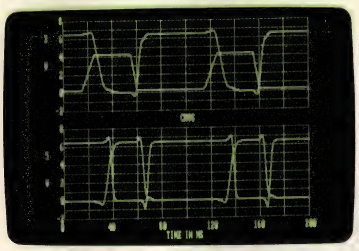
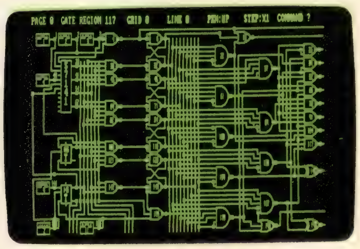




"Typical MICROCAP Transient Analysis"


PAGE 0 GATE REGION 117 GRID 0 LINE 0 PEN:UP STEP:X1 COMMAND ?

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MICROLOGIC provides you with a similar interactive drawing and analysis environment for digital work. Using standard PC hardware, you can create logic diagrams of up to 9 pages with each containing up to 200 gates. The system automatically creates the netlist required for a timing simulation and will handle networks of up to 1800 gates. It provides you with libraries for 36 user-defined basic gate types, 36 data channels of 256 bits each, 10 user-defined clock waveforms, and up to 50 macros in each network. MICROLOGIC produces high-resolution timing diagrams showing selected waveforms and associated delays, glitches, and spikes—just like the real thing.

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CIRCLE NO 123

Circuit and ground plane share one surface

N Balakrishnan
Indian Telephone Industries Ltd,
Bangalore, India

You can economically produce a pc board that has circuit traces and a ground plane on the same side. Using this pc-fabrication approach, which is less expensive and requires less time and material than do more conventional pc-fabrication techniques, you form a stack that consists of a sheet of photographic film, your circuit artwork, several transparent spacers, and a negative of the artwork. Although this combination appears opaque (for a perfectly aligned artwork and negative), diffraction allows light to bend around edges in the artwork and its negative, creating an image, as shown in **Fig 1a**.

The technique works as follows: First, develop ordinary 4:1 or 2:1 artwork using conventional solder pads for the nongrounded terminals. For the grounded terminals, use pads as shown in **Fig 1b** to allow a short between the terminal and the ground plane. (The grounded pads are available from Bishop Graphics, Westlake Village, CA.) Then photographically reduce the artwork to obtain a 1:1 master and negative **(Fig 1a)**.

Next, form the stack. Begin with a sheet of bright-light duplicating film (available from DuPont, Wilmington, DE) on the bottom. Then add the artwork master, six (typ) 175-μm mylar spacers, and the artwork negative, aligned with the master. Place the stack in a vacuum printing frame (available from Gyrex, Santa Barbara, CA) and expose it to collimated UV light for about 6 sec. In the resulting image, little change occurs in the circuit-trace dimensions because the circuit artwork is next to the film; the blooming effect that isolates the circuit removes some of the ground-plane copper. **EDN**

To Vote For This Design, Circle No 748

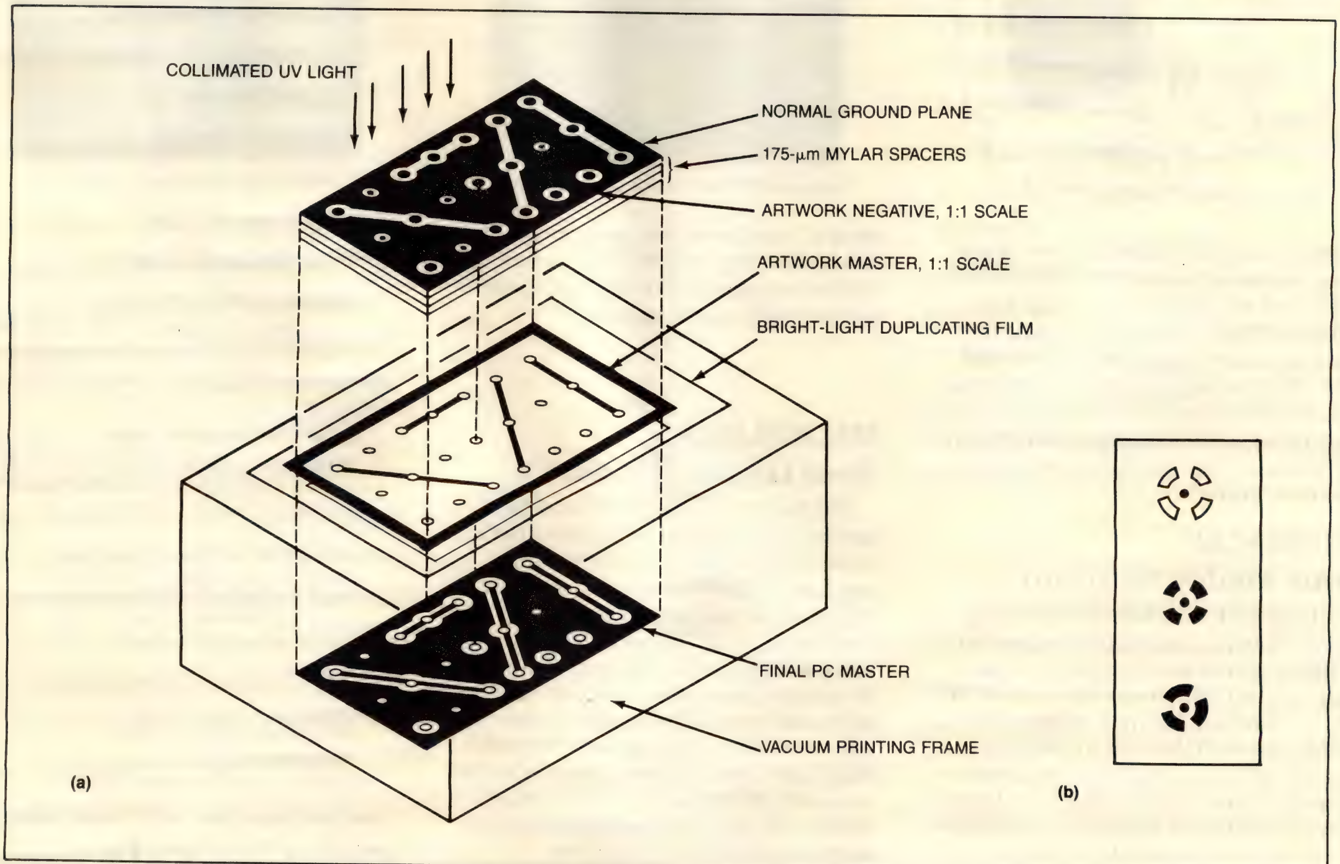

Fig 1—Combine pc artwork with its negative *to form a ground plane on the printed-circuit side of your pc board **(a)**. Grounded solder pads require a pattern **(b)** that allows contact with the ground plane.*

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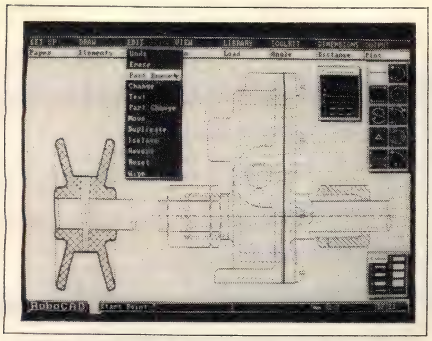

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Robo Systems Corp, 111 Pheasant Run, Newtown, PA 18940. Phone (215) 968-4422.

Circle No 350

CAE INTERFACE

If you own a Paragon or EIS CAD system, you can use this interface software to convert parts and wiring data from a Valid Logic Scaldsystem to a format compatible with your own system. The package can read Valid Logic data either from a 9-track magnetic tape or from an IBM PC-formatted floppy disk into the pc-board design systems. The interface program runs on any system that operates under MS-DOS and requires a 10M-byte hard disk, at least 512k bytes of RAM, and RS-232C cabling. Interface package, $2500; as an upgrade for owners of this company's IBM Link program, $500.

Animat/USA, 200 Brown Rd, Suite 300, Fremont, CA 94539. Phone (415) 659-0105.

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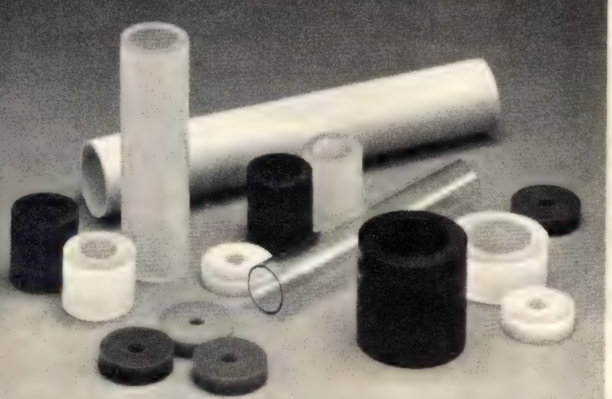

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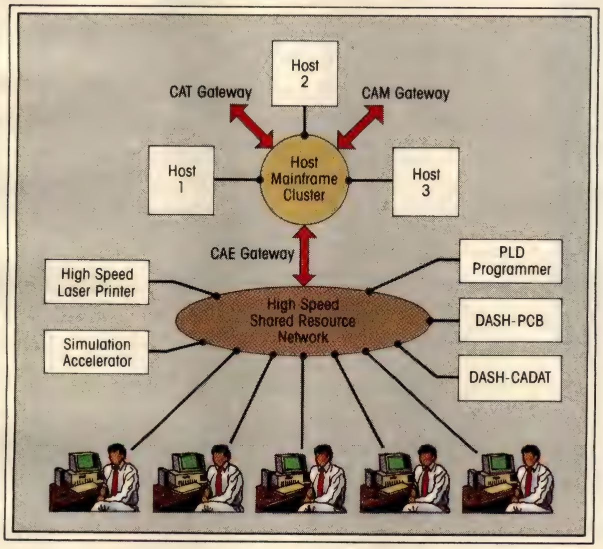

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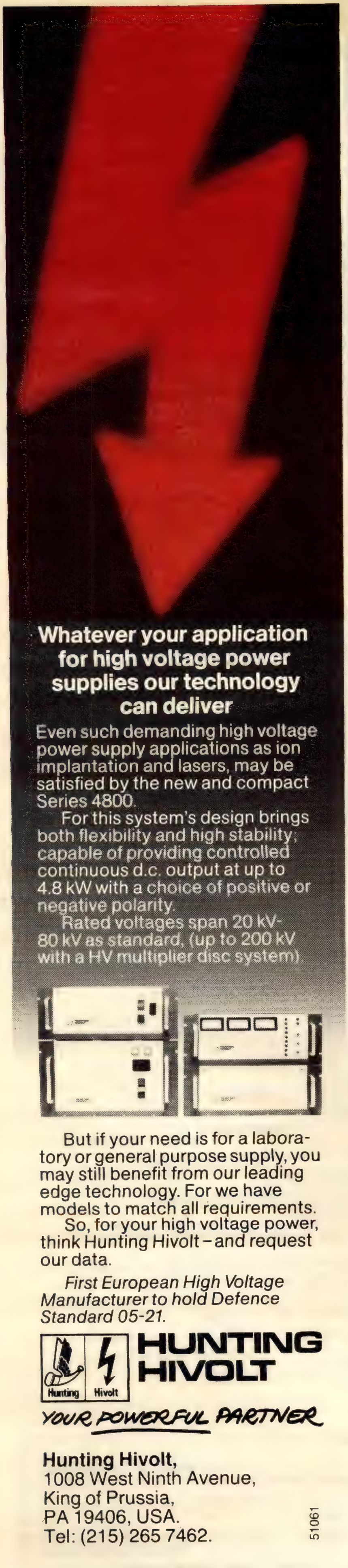

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Digital Equipment Corp, 146 Main St, Maynard, MA 01754. Phone (800) 344-4825.

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WAVEFORM DISPLAY

Oceanview graphically displays the waveforms of simulated signals and lets you view key areas of selected signals. After you have modified a circuit, you can compare that circuit's waveforms with those of your original design. The software runs on IBM PCs and compatible computers that contain 192k bytes of memory. It can record a circuit-simulation run and then repeat the process with one instruction. The number of waveforms that the package can display varies: It can display eight waveforms when you use the IBM color-graphics adapter and 17 waveforms when you use the Hercules color card. Other display adapters for the package include the IBM enhanced color-graphics board, the TecMar Graphics Master, and the AST monochrome card. $1000.

Control Data Corp, 8100 34th Ave S, Minneapolis, MN 55440. Phone (612) 853-4013.

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SYSTEMS-LEVEL CAE

This company's N.2 systems-level CAE package is available for the IBM PC/AT and Masscomp computers. The software supports hierarchical specification, design, functional simulation, and micro/macrocode development of digital systems. The package is also available for other IBM computers as well as Elxsi, Gould, VAX, Apollo, Sun,

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Enterprise Systems	(603) 742-7363
G W Three	(703) 451-2043
Hamilton Standard Digital Systems	(214) 446-2664
Matrix	(919) 833-2837
Micro-Aide	(714) 592-3804
Micro-Link	(800) 428-6155
Micro/Sys	(818) 244-4600
Miller Technology	(408) 395-2032
M.K. Hansen	(800) 521-0714
National Instruments	(512) 250-9119
Octagon Systems	(303) 426-8540
Pro-Log	(408) 372-4593
Sensoray	(415) 657-9331
Solar Wind Systems	(415) 883-0404
Technology 80	(612) 542-9545
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CIRCLE NO 199

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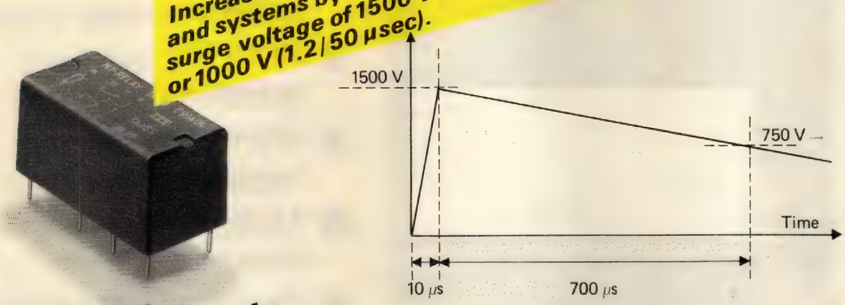

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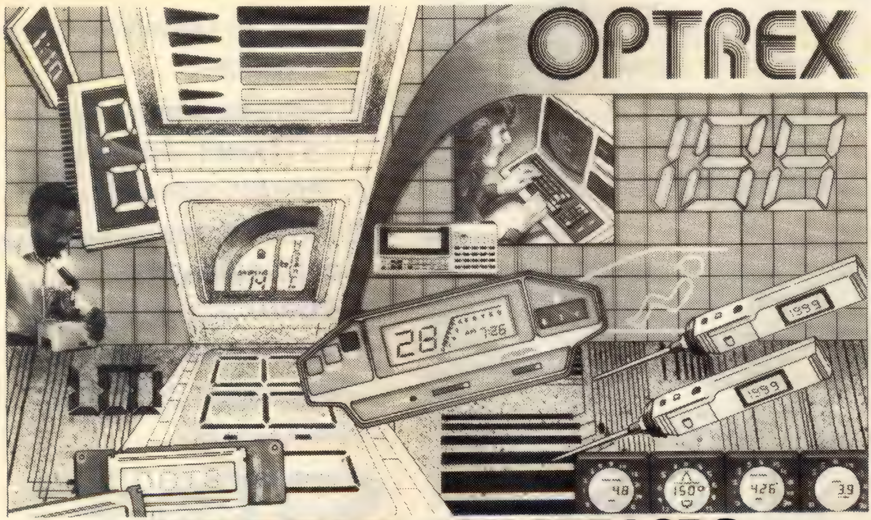
CIRCLE NO 128



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Telephone (313) 557-0018

OPTREX CORPORATION

CIRCLE NO 129

Data General, and Pyramid computers. Single-copy license with binary code provided for the IBM PC/AT, $13,000.

Endot Inc, 11001 Cedar Ave, Cleveland, OH 44106. Phone (216) 229-8900.

Circle No 356

STANDARD-CELL CAD

Gould AMI's standard-cell library is now available for the CAE-2 software system; you can select standard cells from a library of more than 200 electronic functions. Using CAE-2 on an IBM PC/XT or PC/AT, you can design an application-specific IC and simulate *that* design. The PC then produces a net list in AMI's proprietary Bolt language; you can transfer the net list to a mainframe computer for more computationally intensive tasks, such as timing simulation and layout. Or, you can transfer it to AMI, after functional simulation on the CAE system, for verification of the circuit's timing specifications, circuit layout, and fabrication of prototype devices. $7500.

Personal CAD Systems, 981 University Ave, Los Gatos, CA 95030. Phone (408) 354-7193.

Circle No 357

IC-DESIGN LIBRARIAN

Icebox aids users of Autodesk's AutoCAD package in the designing and shaping of integrated circuits. Running independently of AutoCAD, the package contains an editor that can create and edit IC shapes. The editor can also define commonly used symbols such as ground, capacitors, and transistors. $295, including one library; $50 for each additional library.

International Microsystems Inc, 11554 C Ave, Auburn, CA 95603. Phone (800) 325-6028; in CA, (916) 885-7262.

Circle No 358

The Conference That Takes A Hard Look At The Business Side Of Software.

The Software Business Conference April 2 & 3, Los Angeles, California

This prestigious conference, held in conjunction with COMDEX/Winter, will provide a forum for developers, publishers and resellers of software to discuss common interests, challenges, and solutions.

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By bringing the three main bodies of the software industry together at one major conference, the Software Business Conference proposes to raise the visibility of software issues worldwide, and to assist in bringing high quality products to the market.

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Software Business Conference Schedule

Plenary Sessions

A Marriage of Objectives; Keeping Pace with a Changing PC Environment.

Marketing Sessions

What's Selling? The Software Marketplace; Who's Buying? Applications and Users.

General Sessions

Managing the Successful Software Company; Software Development Technical Strategies; Software Development Management Strategies; Exploiting the New Software Product; Supporting the New Software Product; The Great Code Rush: Prospecting for New Packages

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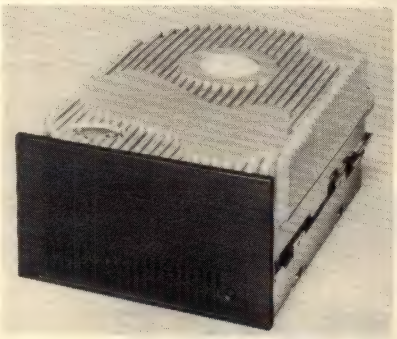

WINCHESTER DRIVES

With data-storage capacities of 86M, 121M, and 173M bytes, MK-150 Series 5¼-in. Winchester drives feature an average random access time of 25 msec and a data-transfer rate of 10M bps. These drives also have a dedicated head-landing zone, an automatic power-down lock, and a voice-coil positioner with center-stack servo. The devices have an MTBF of 30,000 hours and can withstand an operating shock as great as 10g; no preventive maintenance is required. You can operate the drives with either ESDI or SCSI interfaces. $1295 to $1695.

Toshiba America Inc, Disk Products Div, 3910 Freedom Circle, Suite 103, Santa Clara, CA 95054. Phone (408) 727-3939.

Circle No 359

19-IN. COLOR TERMINAL

Suited for CAE and scientific applications, the CT 1024 boasts a display resolution of 1024×768 pixels in its 30-Hz interlaced refresh mode or 512×384 pixels in its 60-Hz noninterlaced refresh mode. The terminal supports nondestructive zoom, pan, and blink and offers an array of graphic primitives in eight or 16 simultaneous colors. The unit also supports interactive applications by offering picture storage, local graphics, and hard-copy output directly from the terminal. You can use input devices such as a light pen or digitizer table with this terminal. It comes with a 19-in. raster scan display, a detachable keyboard with 16 programmable function keys and a numeric keypad, an RS-232C port, and a color look-up table. A rack-mount version is also available. $8495.

Chromatics Inc, 2558 Mountain Industrial Blvd, Tucker, GA 30084. Phone (404) 493-7000.

Circle No 360

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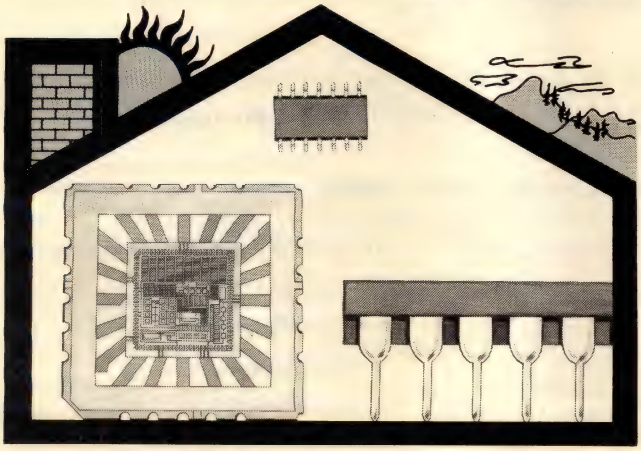

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• Built-in RAM and ROM tests • Breakpoints can be set in ROM or RAM • Breakpoints and emulation run at full target system speed • Binary or hex programs can be downloaded over RS-232 • Automatically profiles, finding the bottlenecks in your code • Built-in Help function • Assembles/disassembles code, traces execution, traces while skipping subroutines, compares and alters memory, I/O and registers.

The I.C.E. BOX is available from stock for $600.00 each, for the Z80, 8085, and NSC800 processors. Please specifiy which I.C.E. BOX you need when ordering. To order contact Softaid, Inc., P.O. Box 2412, Columbia, MD 21045 (301) 792-8096. Shipping charge is $5.00 per unit. We accept Visa, Mastercard, checks and COD.

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NEC Information Systems Inc, 1414 Massachusetts Ave, Boxborough, MA 01719. Phone (617) 264-8000.

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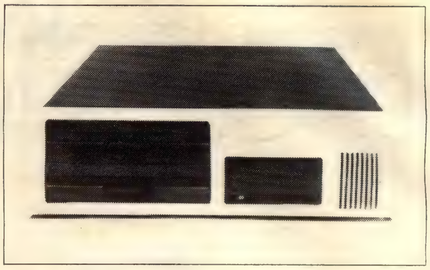

WINCHESTER DRIVE

Providing formatted disk capacities of 70M to 300M bytes, the Model 1340 hard-disk-drive subsystem is compatible with DEC's DU Winchester drive, RX02 floppy-disk drive, and TQK25 tape drive. The subsystem uses standard DEC device addresses and interrupt vectors and includes an emulation function for software-transparent operation under the MicroVMS and Ultrix operating systems. Additional features include a 22-bit controller, an average access time of 20 msec, and a transfer rate of 1.2M bytes/sec. It comes in a desktop or a rack-mount configuration. A bootstrap program, cabling, onboard formatting, and self-diagnostics are provided. A 300M-byte system with 70M-byte tape backup, $13,295.

Chrislin Industries Inc, Computer Products Div, 31352 Via Colinas, #101, Westlake Village, CA 91362. Phone (818) 991-2254.

Circle No 362

PRINTER

Featuring a 12-wire print head, the Office Systems printer produces draft-quality copy at 200 cps and correspondence-quality print at 100 cps. The manufacturer claims that

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Full Z80® performance guaranteed—from the company that invented it.

If your Z80 applications are getting too hot to handle, it's time to turn down the wattage. What better source for a low-power CMOS version of your favorite CPU than the company that designed it in the first place? And, nothing has been left out of Zilog's CMOS implementation of the Z80 to give you the low power, low heat, high noise immunity, temperature tolerances and economical packaging that make CMOS technology so attractive.

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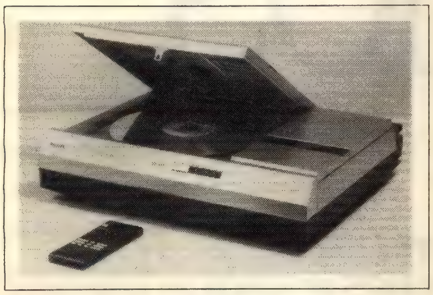
EDN 030686

the printer can achieve an output rate of 200 40-character lpm. Standard features include an automatic sheet feeder, 7-color printing with multicolor ribbon cassettes, graphics functions, and three resident font styles. The printer can accommodate 136 columns of print in 12-cpi compression mode, and its optional clip-on tractor assembly accepts continuous-feed paper. $800 (OEM qty).

Newbury Data Recording Ltd, 20 Vernon St, Norwood, MA 02062. Phone (617) 551-0280.

Circle No 363



VIDEO-DISK DRIVE

Providing computer-controlled interactive retrieval of video, text, sound, and data, the VP 935 video-disk drive lets you address and display as many as 54,000 video images. Its laser optics can scan between two points on a video disk and lock-in in about one second. The laser can jump between points that are fewer than 100 tracks apart without any visually detectable video blanking, permitting seamless video branching. This read-only retrieval system also emulates other manufacturers' video-disk drives, thus increasing the available collection of prerecorded materials you can choose from. Other features include backward and forward scanning as fast as 75× normal playing speed, variable-speed forward and reverse as fast as 20× normal speed, slow-motion forward and reverse as slow as $1/120$th normal playing speed, still frame, and pause. The unit's standard RS-232C interface supports transmission rates to 38.4k baud. An optional 200k-baud RS-422 interface is also available. $1395.

Philips Subsystems and Peripherals Inc, 100 E 42nd St, New York, NY 10017. Phone (212) 850-5125.

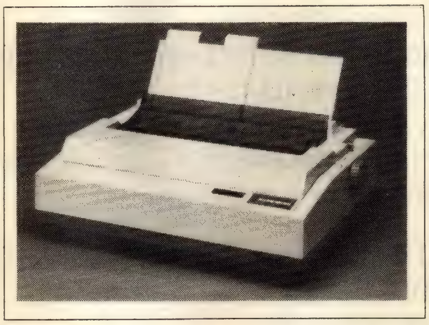
Circle No 364

TITLE GENERATOR

The Video Effects Titler (VET) allows you to superimpose as many as 30 pages of color titles over a camera image or video footage. This computer-based, stand-alone unit has a typewriter-style keyboard for composing and editing titles. On each of the 30 pages, you can display as many as eight lines of 16 upper- and lower-case characters. You can select one of 15 colors for each character. Titles are stored in nonvolatile memory. An expansion port allows you to add new font styles, special effects such as 3-D word zooming, and special logos. $599.95.

MFJ Enterprises Inc, 921 Louisville Rd, Starkville, MS 39759. Phone (800) 647-1800; in MS, (601) 323-5869. TLX 534590.

Circle No 365



DOT-MATRIX PRINTER

You can program the DL2400 printer using its front-panel 16-character LCD to select print mode, font style, character set, and language. This 24-wire, letter-quality, dot-matrix printer has a low noise level of 55 dBA and a 6000-hour MTBF. Draft-mode print speed is 216 cps, and letter-quality print speed is 72 cps. The printer comes with a bidirectional tractor-feed mechanism, an 8k-byte input buffer, and 24k bytes of RAM for downloading fonts

RCA VP600 Series Keyboards are available through these representatives:

CALIFORNIA
L.C.O. Technical Sales
750 Camden Avenue
Campbell, CA 95008
408-378-9900

Seevid
15178 Transistor Lane
Huntington Beach, CA 92649
714-898-6100
213-594-4444

COLORADO
Cleveland Ent. of Colorado
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Colorado Springs, CO 80916
303-597-8872

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Southeast Data Products
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Altamonte Springs, FL 32714
305-788-3666

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312-394-5441

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Overland Park, KS 66212
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VP608. Same as VP606, less case and speaker. Includes assembled keypad and circuit board. $134*.

VP616. All features of VP606 and VP601 in a serial output format, with 16-key numeric keypad. $194*.

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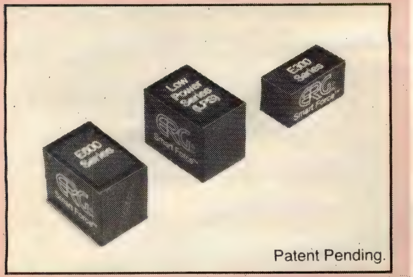

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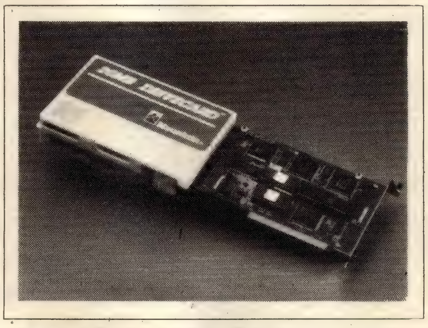
CIRCLE NO 137

(eg, Courier 10 and Prestige Elite). In addition, the printer has dual Centronics and RS-232C interfaces. It's also available in a 7-color version—the DL2401. $1195.

Fujitsu America Inc, Peripheral Products Div, 3055 Orchard Dr, San Jose, CA 95134. Phone (408) 946-8777. TLX 176207.

Circle No 366



HARD-DISK CARD

The Drivecard provides your IBM PC or compatible computer with 20M bytes of hard-disk storage. Using this hard-disk card simplifies file transfer during hardware upgrades: You can shift data from your PC to a PC/XT or PC/AT by transferring your Drivecard to the new computer. The factory-formatted device has the storage-capacity equivalence of 58 floppy disks. The unit plugs into your computer, which immediately recognizes the disk as Drive C. You will, however, have to reposition your PC's speaker to other existing chassis holes. The unit contains a 3½-in. Winchester disk drive and occupies one-and-a-half card slots in a PC. $1195.

Mountain Computer Inc, 360 El Pueblo Rd, Scotts Valley, CA 95066. Phone (800) 458-0300; in CA, (800) 821-6066. TWX 910-598-4504.

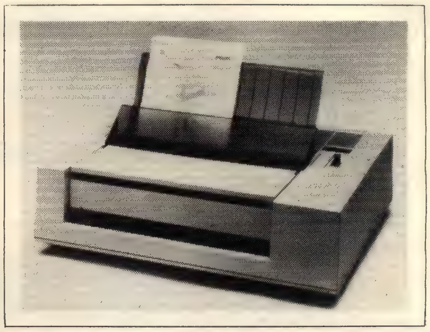
Circle No 367

DOT-MATRIX PRINTER

Boasting a draft-quality print speed to 540 cps, the NP-2410 dot-matrix printer features a print head with 24 8-mil wires. In letter-quality mode, the printer produces 180 cps. It emulates the Epson LQ-1500 printer. You can expand the printer's 4k-byte input buffer with an optional 48k-byte buffer module. In addition, you can order either a Centronics parallel or an RS-232C interface. Optional font cartridges let you select additional print styles. $1845.

Nissho Information Systems, 3838 Carson St, Suite 105, Torrance, CA 90503. Phone (213) 543-1885.

Circle No 368



IMPACT PRINTER

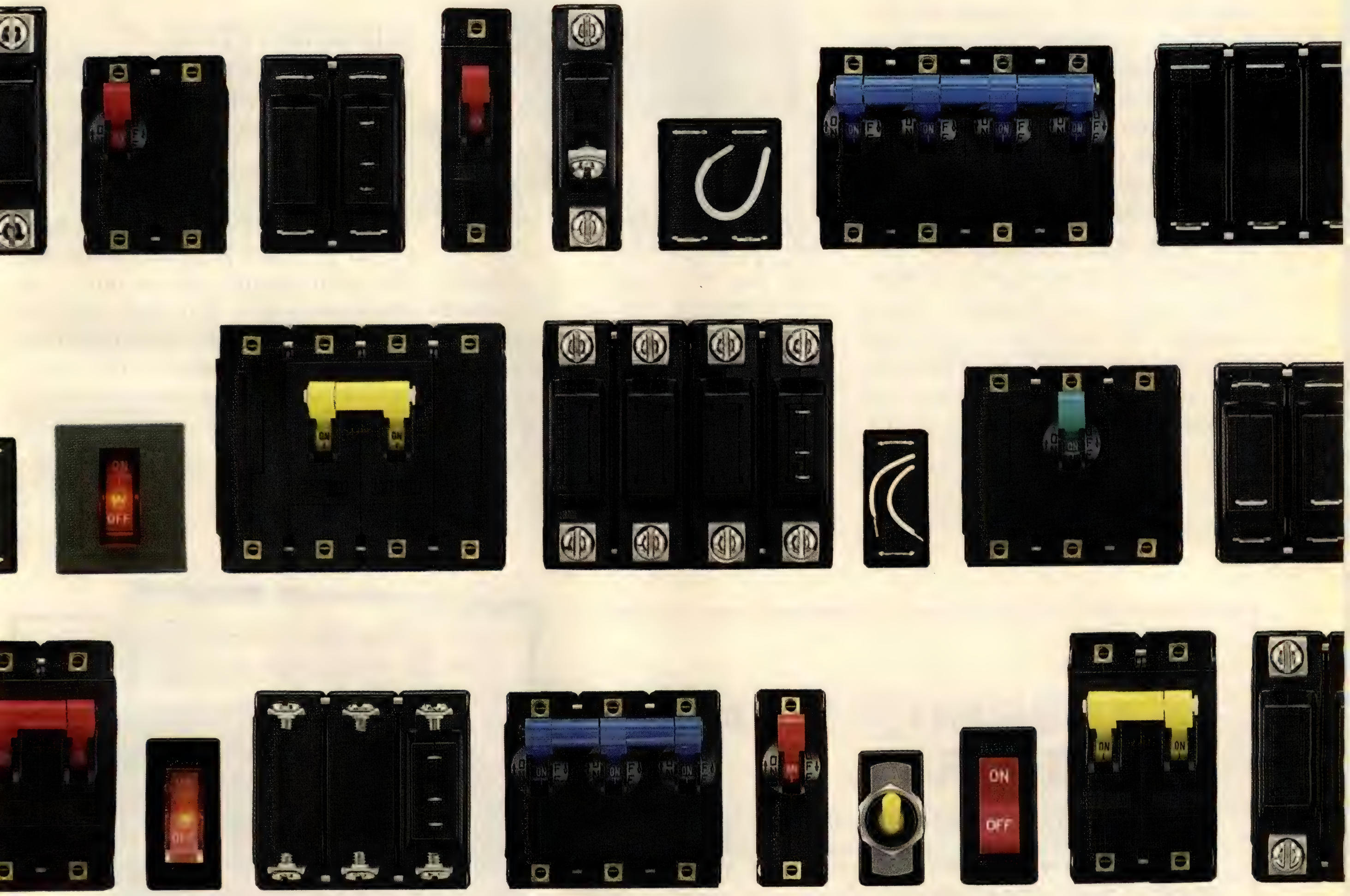
The GP 300 LC letter-quality printer prints colors and graphics at 120 cps. It also offers draft-quality printing at 300 cps. The unit uses 18 tungsten alloy needles that are 0.012 in. in diameter. The needles are positioned in two staggered rows of nine; an electromagnetic solenoid controls each needle. You can select from more than 95 character fonts. Gothic-character fonts come with the printer; the other fonts are available as options, which you download to the printer's µP from software. As many as nine fonts can simultaneously reside on an optional EPROM board. The print mechanism produces an 18×25-dot matrix in letter-quality mode and a 9×9-dot matrix in draft mode. Graphics resolution reaches 144×144 dots/in. $3200.

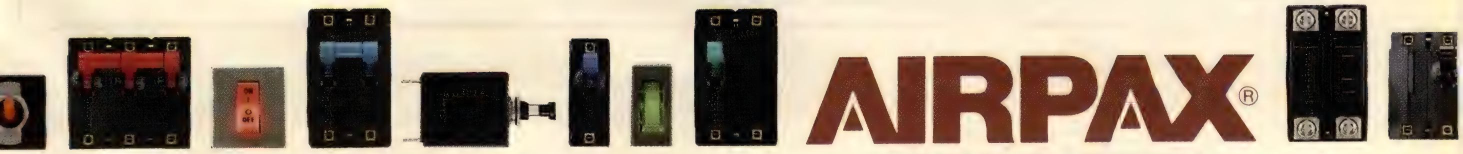
Philips Peripherals Inc, 385 Oyster Point Blvd, Unit 12, South San Francisco, CA 94080. Phone (415) 952-3000.

Circle No 369

VDE APPROVED.

Only Airpax gives you real design freedom with VDE approved magnetic circuit breakers. From 50 milliamps to 50 amperes, in more than 50 configurations and styles. Only Airpax VDE approved breakers can help open your world markets. Airpax Corporation, Cambridge Division, Woods Road, Box 520, Cambridge, MD 21613. (301) 228-4600. A North American Philips Company.





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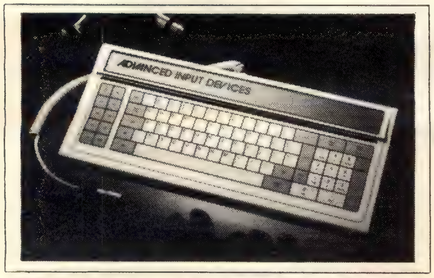
CAMBRIDGE DIVISION

CIRCLE NO 138



INDUSTRIAL KEYBOARD

Designed specifically for industrial use, the PKD-83 keyboard employs a sealed, gasketed top enclosure, which makes it well suited for harsh environments. It features a snap-action, stainless-steel, metal-dome, key-switch construction for true ergonomic tactile feedback. The key panel has 83 keys, including function keys, numeric characters with mathematical function keys in calculator format, and separate cursor controls. The keyboard requires an electrical input of 5V dc at 200 mA. Key travel measures 0.017 in., and key-actuating force equals 11 oz. Operating range spans 32 to 140°F. $100 (OEM qty).

Advanced Input Devices, W 250 AID Dr, Coeur d'Alene, ID 83814. Phone (208) 765-8000. TWX 510-776-0584.

Circle No 370

REED RELAYS

Blue Boy reed relays are available with form 1A, 1B, or 1C contact arrangements. The relays switch from 0.5 to 1A at 200 to 350V (10 to 50W max). The package measures 1×0.31×0.375 in. A slightly larger version (1.17×0.385×0.44 in.) is designed for power switching; it provides spacing and isolation that meets VDE standards. All relays are UL and CSA recognized. Form 1A versions, $0.97 (1000).

Elec-Trol Inc, 26477 N Golden Valley Rd, Saugus, CA 91350. Phone (805) 252-8330. TLX 181151.

Circle No 371

A/D SUBSYSTEM

The HI-9674 A/D-converter subsystem combines the company's monolithic HA-5320 sample/hold amplifier and 12-bit, 2-chip HI-674 A/D converter in a 32-pin plastic DIP. This single-package sampling converter provides a 77-kHz sampling rate with 150-nsec access time to a microprocessor's data bus. The A/D-converter section converts 12 bits in 8 μsec and includes a 10V reference, a clock, 3-state outputs, and a CMOS digital interface for micro-

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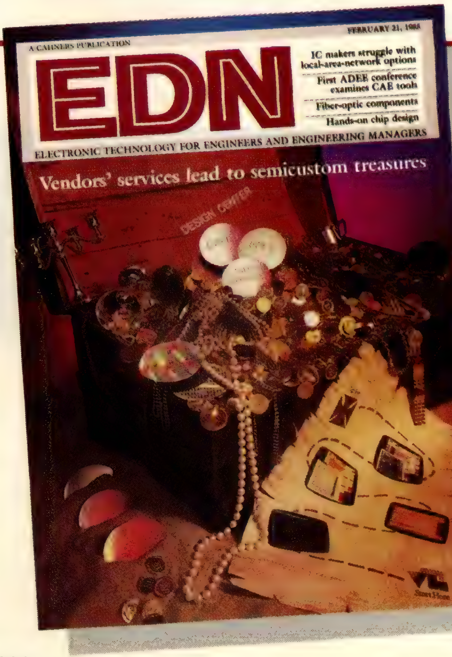


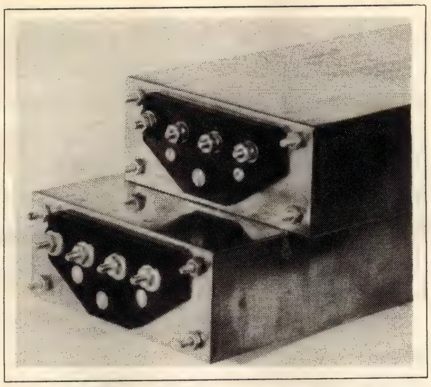
A CAHNERS PUBLICATION
FEBRUARY 21, 1985
EDN
IC makers struggle with local-area-network options
First ADEE conference examines CAE tools
Fiber-optic components
Hands-on chip design
ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS
Vendors' services lead to semicustom treasures

processor control. The HA-5320 sample/hold circuit features a 1-μsec acquisition time (to ±0.01%), and includes an input transconductance amplifier, a low-leakage analog switch, and an output integrating amplifier. This chip includes a hold capacitor. Power requirements are ±15 and 5V, with a typical dissipation of 900 mW. $61.34 (100).

Harris Corp, Semiconductor Sector, Box 883, Melbourne, FL 32901. Phone (305) 724-7800.

Circle No 372

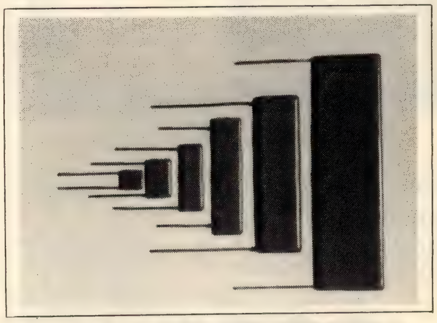
3-PHASE FILTERS



You can reduce electromagnetic interference in equipment with balanced or unbalanced 3-phase loads using these delta and wye filters. Pi and T configurations are also available for high- and low-impedance loads. In addition, you can order a 100-μH inductor in the ground circuit for ground-current isolation. Available with 20, 30, and 60A current ratings, the filters offer a 250V rms voltage rating and are suitable for 50- and 60-Hz line-frequency systems (they may also be used at 400 Hz). Units are tested at 2250V for line-to-ground interference and 1450V for line-to-line interference. You can parallel filters for higher current requirements, and the wye types can be used in 440V systems. Housing dimensions are 5.50× 2.25 × 6.50 in. or 9.50 in. The filters are UL recognized and CSA certified. $130. Delivery, stock to eight weeks ARO.

Stanford Applied Engineering, 340 Martin Ave, Santa Clara, CA 95050. Phone (408) 988-0700.

Circle No 373



THICK-FILM RESISTORS

The Slim-R Series thick-film resistors offer a 0.1-in. profile with voltage ratings as high as 30 kV and wattage ratings from 0.25 to 8W. These noninductive ruthenium resistors offer temperature coefficients from 50 to 250 ppm/°C

EMI/RFI?

SOURIAU'S FILTER CONNECTORS

LM CREATION 85

Among the major problems facing the electronics industry today are the protection of equipment against electromagnetic interferences and the compliance to FCC, VDE, and MIL-STD 461 A/B regulations.

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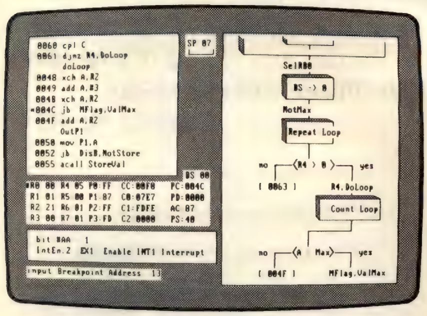
CIRCLE NO 125

IBM-PC based microcomputer development tools!



```
0060 cpl C                         SP 07
0061 djnz R4,DoLoop
     doLoop
0048 xch A,R2
0049 add A,#3
004B xch A,R2
*004C jb  MFlag,ValMax
004F add A,R2
     OutP1
0050 mov P1,A
0052 jb  DisB,NotStore
0055 acall StoreVal
                                   BS 00
*R0 00 R4 05 P0:FF  CC:00F0  PC:004C
 R1 01 R5 00 P1:07  C0:07E7  PD:0000
 R2 21 R6 01 P2:FF  C1:FDFE  AC 07
 R3 00 R7 01 P3:FD  C2 0000  PS:40

 bit #AA    1
 IntEn.2  EX1  Enable INT1 Interrupt
input Breakpoint Address  13
```

(8051 debug/simulator shown)

Your IBM PC can Assemble, debug and program (EPROM) code for these popular microcomputers:

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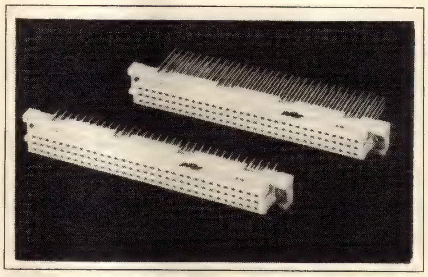
CIRCLE NO 140

over the −55 to +125°C operating range. Resistance values to $10^9\Omega$ are available with tolerance values of 1, 2, 5, 10, and 20%. You can choose flame-retardant epoxy or glass-coated packages in six standard sizes, and pc-board mounting doesn't require that you bend the leads. $0.17 to $0.84 (OEM qty).

Thickfilm International, Box 85-0, Indian Head, MD 20640. Phone (301) 375-8666. TWX 710-829-0590.

Circle No 374

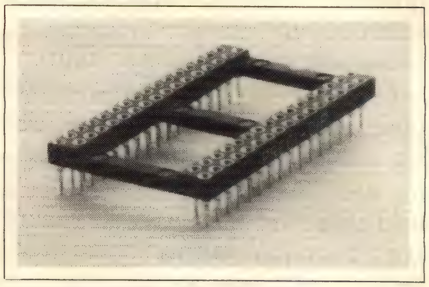


DIN CONNECTORS

Designed primarily for backplane applications, RNE Series inverse DIN 41612 connectors feature compliant pins. You press the male compliant pins into plated-through holes in the backplane to establish a solderless, gas-tight connection. Units are available with 32, 64, or 96 contacts, with either 6- or 13-mm tail lengths. All connectors are UL listed. $0.06 per contact (100). Delivery, six weeks ARO.

Robinson-Nugent Inc, 800 E Eighth St, New Albany, IN 47150. Phone (812) 945-0211.

Circle No 375

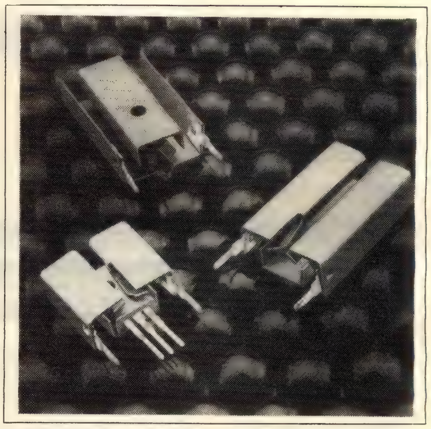


CHIP-SET SOCKET

This 64-pin IC socket meets the design needs of the layout configuration of Rockwell's R6500 Series of modem microprocessors, which come in quad in-line packages. The socket features a beryllium copper contact that provides low insertion forces averaging 3.2 oz per pin. Four points of contact uniformly distribute contact force. A 45° funnel entry base eases insertion, and the brass sleeves prevent wicking and contamination by flux and solder during the assembly process. The standard plating is 16 μin. of gold on the contact with tin plating on the sleeve. The sockets are also available with platings of 30 μin. of gold on the contact with tin on the sleeve or tin on both the contact and the sleeve. $2.18 (100). Delivery, six to eight weeks ARO.

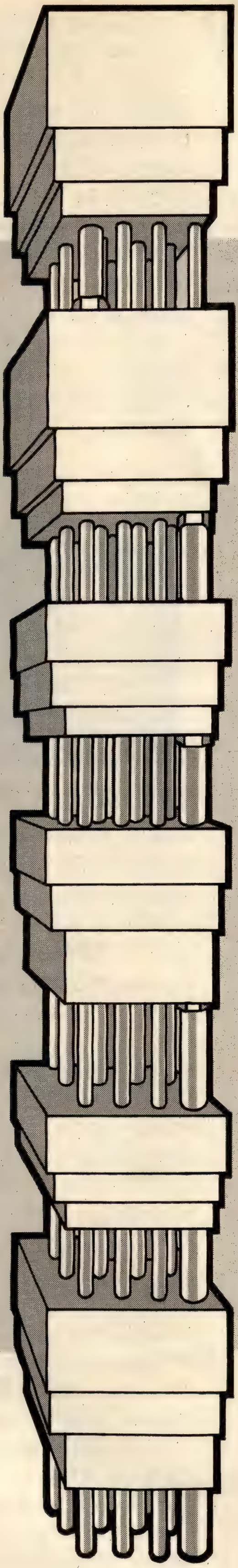
IEE Inc, Component Products Div, 7740 Lemona Ave, Van Nuys, CA 91405. Phone (818) 787-0311. TWX 910-495-1707.

Circle No 376



HEAT SINKS

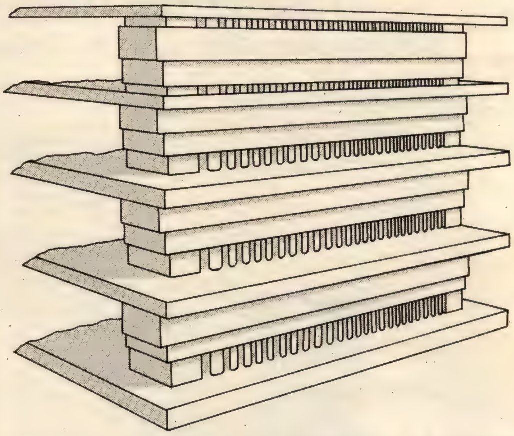
Designed for TO-220 semiconductor devices, Series 5933 heat sinks feature a patented plug-in design that cuts down on assembly time. Stepped tabs provide a tight fit between heat sinks and pc boards, ensuring greater component stability and a more durable board design. The termination design features a spring-action clip that holds the heat sink firmly to the semiconductor, eliminating air gaps and improving thermal efficiency. Vertical fins are suitable for applications re-



STACK THE CARDS IN YOUR FAVOR

Average contact insertion forces of one ounce ease the task of parallel board stacking.

The KS Series connectors incorporate sockets on one side and socket tails serving as mating pins on the other. Printed circuit boards can be placed one on top of another with all electrical connections between boards routed through the stacking connectors.



Hypertronics' connectors utilize the Hypertac® contact design, a hyperboloid shaped socket. The Hypertac® is formed by multiple wires that stretch and wrap around the mating pin to create multiple contact paths. This design results in several major advantages:

- contact resistance as low as .0005 ohms
- extremely low insertion/extraction force (as low as ½ ounce)
- absolute continuity under extremes of shock and vibration (tested below 10 n.s.)
- extended life exceeding 100,000 cycles with consistent repeatability

For more information on these versatile connectors, call Toll Free 1-800-225-9228, or write for a copy of our complete 1986 catalog.

HYPERTRONICS CORPORATION

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"NEW HORIZONS IN CONNECTORS"

CIRCLE NO 141

quiring tight spacing. These devices are made of an aluminum alloy with a black anodized finish and are available in heights of 0.690, 0.750, and 1.375 in. $0.185 for a 0.75-in.-high unit (1000).

Aavid Engineering Inc, Box 400, Laconia, NH 03247. Phone (603) 524-4443.

Circle No 377

SOLID-STATE RELAYS

These miniature panel-mount solid-state relays come with screw terminals (MSSR Series) or push-on tab-type terminals (TSSR Series). Both series are optoisolated and offer synchronous, zero-voltage switching. Inputs are TTL/CMOS compatible, and high-voltage triac outputs with built-in RC snubbers are standard. Load ratings at 120/240V ac are 3 or 12A (MSSR Series), and 3, 12, or 30A (TSSR Series). In both series, the maximum digital-input current can be specified as 5 mA for input voltages from 3 to 32V (MSSR- or TSSR-10), or as 12 mA for input voltages from 3.5 to 8V (MSSR or TSSR-80). $7.22 (1000) for a 12A, 120V ac model. Delivery, stock to six weeks ARO.

Antex Electronics Corp, 16100 S Figueroa St, Gardena, CA 90248. Phone (213) 532-3092. TWX 910-344-7381.

Circle No 378

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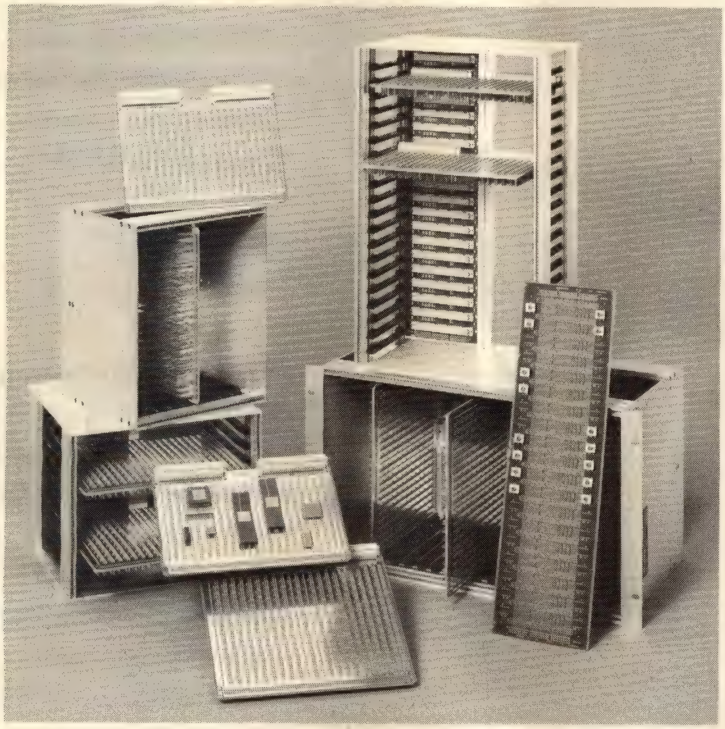

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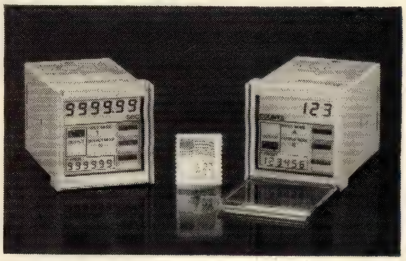

TIMER/COUNTERS

H8CA Series timer/counters with 6-digit LCD readouts feature an elapsed time display selectable for 0 to 999999 sec, 0 to 99999.9 minutes, or 0 to 99999.9 hours. You can set the timer/counters for time-limit operation, on-delay, and automatic reset with either 1-shot output or continuation of timing. Each unit allows reversible counting using two count inputs and count-up action using one input. Total count range is 0 to 999,999. A choice of voltage and nonvoltage count-input models offers counting speeds of 30 cps or 1k cps. The series includes contact and solid-state output models, available as spdt types rated at 3A, 250V ac, or open-collector models rated at 100 mA max, 30V dc. You can choose from versions with supplies of 24 to 240V ac, 50/60 Hz or 12 to 120V dc. $100.

Omron Electronics Inc, 1 E Commerce Dr, Schaumburg, IL 60195. Phone (800) 826-6766; in IL, (312) 843-7900. TWX 910-291-0426.

Circle No 379

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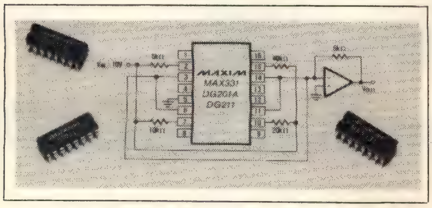

ANALOG SWITCHES

These NO, quad spst analog switches, the DG201A, MAX331, and DG211, use CMOS processing. The switches guarantee latch-up-free operation in situations entailing the removal of power supplies while analog input signals are still connected. The DG201A (which is compatible with industry-standard devices) and the proprietary MAX331 spec turn-on times of 600 nsec max and turn-off times of 450 nsec max. The MAX331 draws 100-μA max supply current over a guaranteed ±4.5 to ±18V supply range; the DG201A draws 2 mA from ±15V supplies. The DG211 specs a turn-on and -off time of 1000 and 450 nsec max, respectively. Unlike other pin-compatible units, this model needs no logic supply for operation. The MAX331 and DG201A are housed in 16-pin ceramic DIPs; the DG201A and DG211 are available in SO packages and 16-pin plastic DIPs. MAX331, $8.80; DG201A, $3.55; DG211, $1.60 (100).

Maxim Integrated Products, 510 N Pastoria Ave, Sunnyvale, CA 94086. Phone (408) 737-7600.

Circle No 380

CMOS EPROMs

This family of low-power, CMOS-based EPROMs now comes in 64k-bit (VT27C64), 128k-bit (VT27-C128), and 512k-bit (VT27-C512) versions, in addition to the VT27C256 256k-bit EPROM. The EPROMs use a 12V programming voltage and offer access-time specs ranging from 150 to 250 nsec. The devices have an automatic power-down mode, controlled by the chip-enable input. They also feature an output-enable function, which eliminates bus contention. The TTL-compatible EPROMs come in 28-pin ceramic DIPs; 64k-, 128k-, and 512k-bit devices cost $4.50, $7.81, and $15.28 (5000), respectively.

VLSI Technology Inc, 1109 McKay Dr, San Jose, CA 95131. Phone (408) 434-3000.

Circle No 381

RAMS CONTROLLERS

The DP8428 and DP8429 1M-bit dynamic-RAM controller/drivers are additions to the DP8400 family. They drive 8M bits of dynamic RAM and work with CPUs at 10 MHz (or higher) with no wait states. Each device integrates onboard refresh counters, row/column multiplexing logic, row/column bank-address latches, RAS bank-decoding logic, and precise control and timing logic

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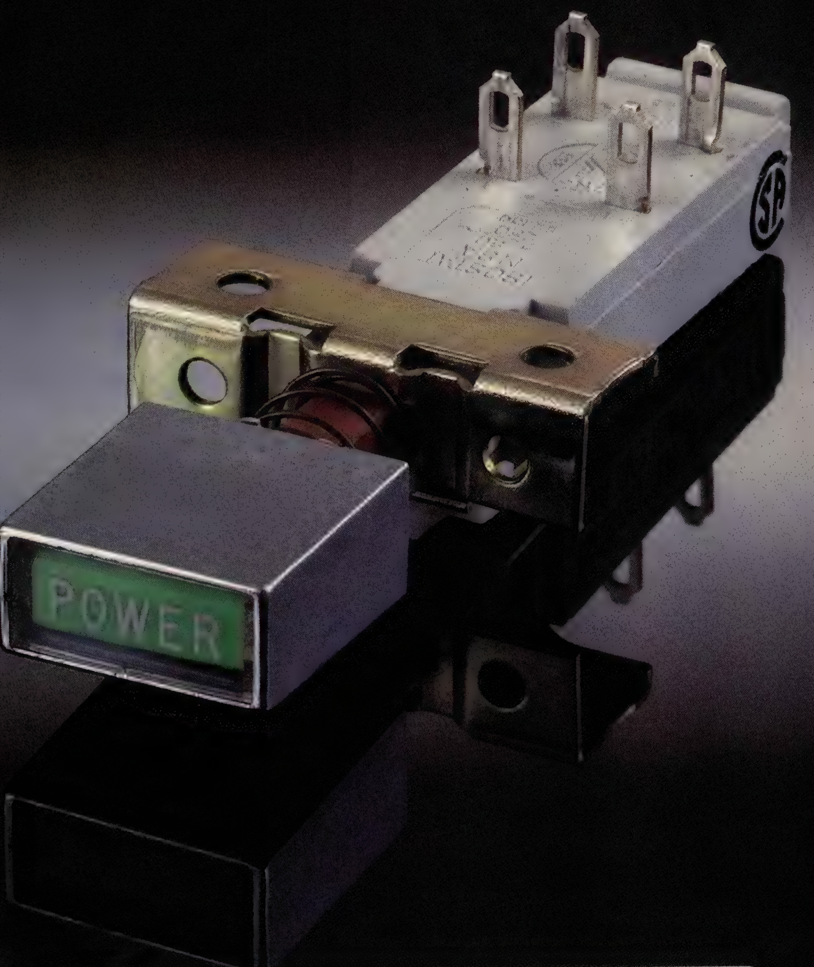

ITT Schadow's Power Switches

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For details on ITT Schadow Power Switches – or for information on ITT Schadow's custom switchmaking and worldwide sourcing – mail the coupon below. Or contact your local Authorized ITT Schadow Switch Center.

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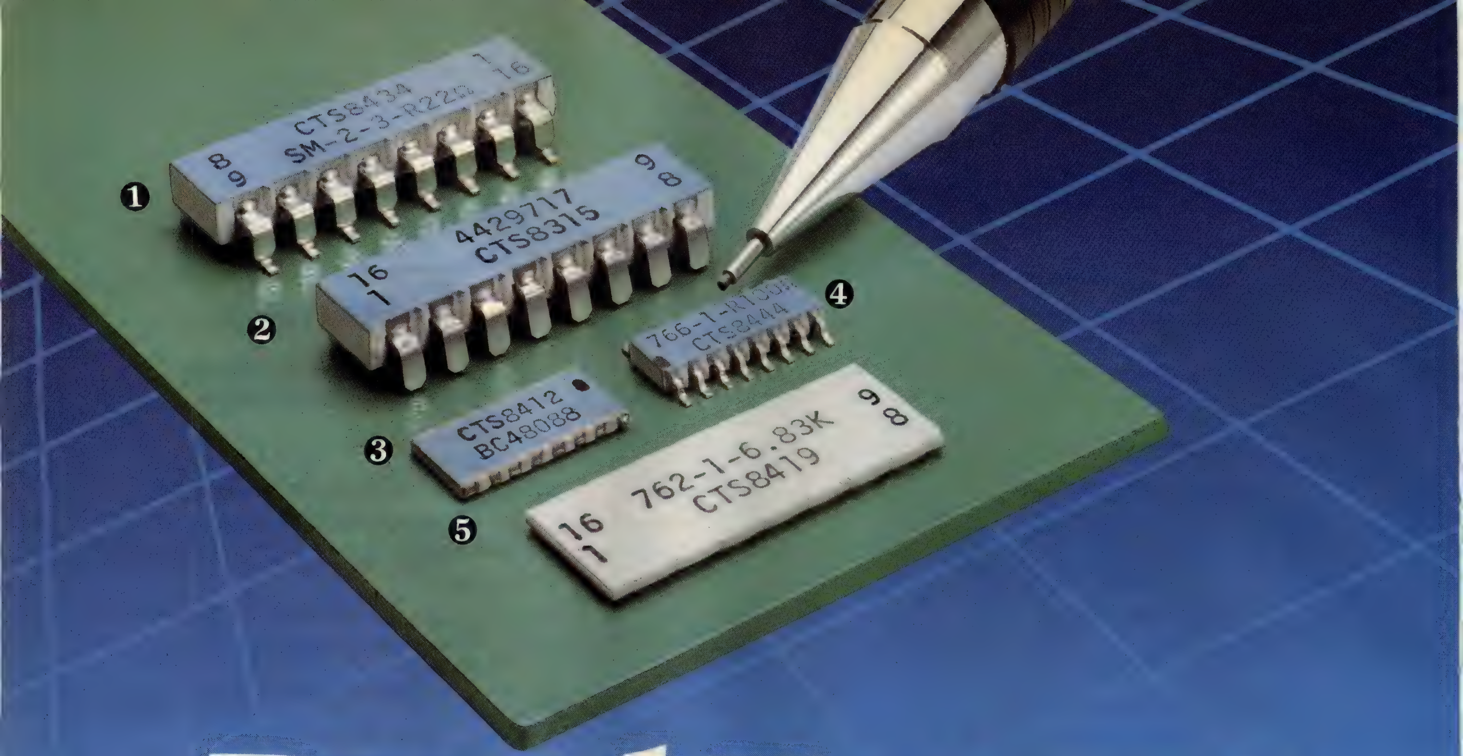

Board Huggers

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BOARD HUGGER RESISTOR PACS shown on board above.

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Available with 8, 14, 16 or 18 leads.

❷ **Stub Lead Series 760**
Available with 8, 14, 16 or 18 leads.

❸ **Leadless Series 765**
Available with 8, 14, 16 or 18 solder pads.

❹ **Small Outline Series 766**
Available with 14 or 16 leads.

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CIRCLE NO 145

Engineer's Experimentation Kit for CTS Surface Mount Resistor Networks

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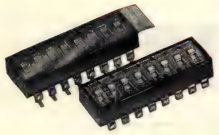
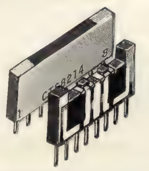


Series 207—Surface mount, process compatible AUTO-DIP™ Switches
Phone: (805) 238-0350
CIRCLE NO 146

Series SMXO-55 Surface mount hybrid clock oscillator
Phone: (815) 786-8411
CIRCLE NO 147



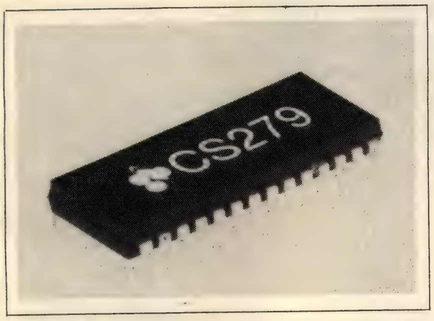
Series 750 R/C Machine insertable Resistor/Capacitor SIP networks
Phone: (219) 589-8220
CIRCLE NO 148

Series CCXO-140 Leadless chip carrier crystal oscillator for surface mounting
Phone: (815) 786-8411
CIRCLE NO 149

for sequencing dynamic-RAM-access and -refresh tasks. They're available in JEDEC-standard 52-pin DIPs and 68-pin plastic chip carriers. $45 (100).

National Semiconductor Corp, Box 58090, M/S 23-200, Santa Clara, CA 95052. Phone (408) 721-5000. TWX 910-339-9240.

Circle No 382



DISK-DRIVE IC

The CS-279 disk-drive IC, a stepper-motor driver and logic interface for floppy-disk drives, provides all the logic functions needed for a standard disk drive. The IC also contains two high-current bridge outputs that you can connect directly to a bipolar stepper motor. In addition, it has high-current, open-collector outputs that you can connect directly to the host computer or interface. Three comparators on the circuit can work in tandem with photosensors or switches to detect three signal types: index pulses, track-00 signals, and write protection. An on-chip pulldown resistor provides a current path for the sensors. The logic accommodates full or half stepping, and the stepper driver provides output currents as high as 275 mA. An externally programmed one-shot determines the time delay for the ghost pulse; you can defeat the function by grounding the one-shot pin. In a 28-pin plastic DIP, $4.50 (1000).

Cherry Semiconductor Corp, 2000 S County Trail, East Greenwich, RI 02818. Phone (401) 885-3600. TLX 6817157.

Circle No 383

B•A•S•I•C ASIC™

HIGH-PERFORMANCE SOLUTIONS, FROM THE LEADER IN BIPOLAR ASIC.

When an ordinary gate array just won't do, look to VTC . . . the leader in bipolar analog/digital semicustom ICs.

BasicASIC™ is a complete family of advanced-technology, 2- and 3-micron solutions with the performance only bipolar can provide . . . f_t to 6GHz, clock speeds to 500MHz, amplifier bandwidth to 200MHz, and low noise to 1nV/$\sqrt{Hz}$.

These high-performance, easy-to-use solutions for analog/digital systems and subsystems are field-proven and available in a variety of industry-standard packages . . . for either commercial or military applications:

☐ VJ800 Analog Master Chip Family.
☐ VL1000 Analog/Digital Standard Cell Library.
☐ VL2000 Digital Standard Cell Library.

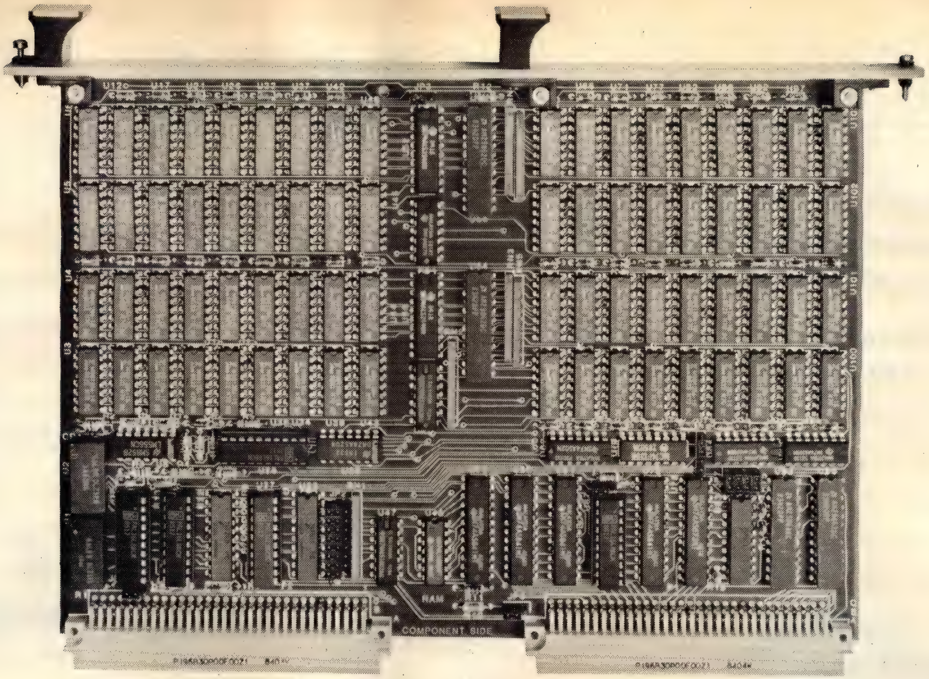
VTC provides complete design and fabrication services, which means better security for you. We have the latest state-of-the-art facilities and equipment . . . from design and mask-making, through wafer fabrication, to packaging and testing.

And, we stand behind you with extensive support services—including Design Systems with complete documentation and workstation software, including PC AT . . . technical seminars . . . CAD and applications engineering support . . . and regional design centers.

So, when you're ready to get down to the basics of ASIC, simply pick up the phone and call us at:

1-800-VTC-ASIC

VTC Incorporated



Model 1501A RAM board features 200 ns access time, 24 bit addressing capability and 8 and 16 bit data paths.

THANKS TO SOME VERY ADVANCED ENGINEERING, 2 MEGABYTES OF VMEbus* MEMORY AT A VERY MEMORABLE PRICE.

Model 1501A, 2 megabyte memory board is another example of our commitment to manufacture the best products for the money. But that's only the beginning.
A one megabyte version is available for only $560 QTY. 100.

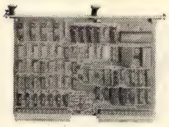
And where your design calls for high-speed memory, Grant also manufactures a 150 ns version in 1 and 2 megabyte configurations.

You already know us for our line of Q-bus* products, now you can count on us for VME.

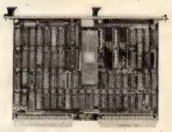
Call or write for more information on our comprehensive line of bus compatible products or for our free catalog to: Grant Technology Systems, 11 Summer Street, Chelmsford, Massachusetts 01824. (617) 256-8881 or TELEX: 510-600-8133. European Division: Dublin 17, Ireland. Telephone: 011-3531-483-566 or TELEX: 30104.

$900
QTY. 100.

Take a closer look at our line of VMEbus products and you'll agree that we've got the price/performance edge.



Model 1301. This 8-line asynchronous serial interface board offers the lowest cost per line. If you're looking for a means of interfacing printers, terminals or modems to a VME system, and you don't need all the frills, this is it. Only $486 QTY. 100.



Model 1601. The only SCSI/DMA interface board that is both VME and MVMX32* compatible. Featuring a high-speed private interconnect bus for multiple processor configurations, DMA controller and full function SCSI controller for mass storage devices. You get all this performance for only $696 QTY. 100.

COMPUTER PRODUCTS™
GRANT TECHNOLOGY DIVISION

---

*Q-bus is a registered trademark of Digital Equipment Corporation.
VMEbus and MVMX32 are registered trademarks of Motorola, Inc.

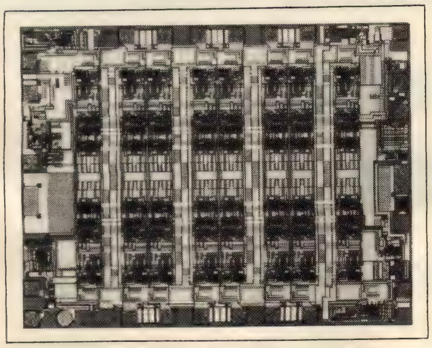
ICs & SEMI-CONDUCTORS

DISK-DRIVE CHIP

The SSI 541 read data processor suits use with Winchester disk drives. The chip performs amplitude and time-pulse qualification for modified-frequency-modulation and run-length-limited encoded systems having data rates to 15M bps. It contains a wide-dynamic-range AGC amplifier, a dual-rate AGC charge pump, an active differentiator, an adjustable-hysteresis comparator, a feed-forward hysteresis level-control circuit, and a gating circuit with output pulse-width control. Feed-forward hysteresis control improves write-to-read recovery time and data recovery during media dropouts/ins. The processor also includes individual-amplitude and time-channel input ports for increased flexibility. It operates from 5 and 12V supplies and comes in a 24-pin DIP or a 28-pin PLCC. $13.43 to $14.72 (1000).

Silicon Systems, 14351 Myford Rd, Tustin, CA 92680. Phone (714) 731-7110.

Circle No 384



SHIFT REGISTER

This parallel-to-serial video shift register, the bipolar Am8177 video data serializer, has a 200-MHz clock rate and suits use in high-speed, bit-mapped graphic systems. It can accommodate video words in 16-bit increments. Parallel data inputs are TTL compatible; the clock and serializer controls are ECL compatible. A set of latches between the parallel-data input pins and the shift register allows the next word of

B·A·S·I·C ASIC™

VJ800

Analog Master Chip Family:

VJ800 FAMILY	*VJ800*	*VJ860*	*VJ830*
Transistors	636	408	188
Resistors	706	558	248
Capacitors	18	18	8
Total Components	1360	984	444
Chip Size (mils)	126x126	110x106	79x83
Pin-Outs	40	40	28

For Versatile, Quick-Turn Linear ASIC Applications.

The VJ800 Analog Master Chip Family is a cost-effective solution for linear applications.

These high-performance integrated circuits contain very high component-counts, allowing interconnection of densely packed analog functions.

VJ800 Analog Master Chips feature NPN f_t to 1GHz, PNP f_t to 100MHz, economical chip sizes, two-layer metal, and routing over unused components.

The VJ800 Family is ideal for low-noise, high-bandwidth applications—including computer peripherals, instrumentation, telecommunications, discrete circuit replacement, analog signal processing, linear/digital subsystems, and linear LSI subsystems.

What's more, you can quickly and easily do PC or workstation-based schematic entry and simulation with the VJ800 Design System.

VTC Incorporated

Hughes' Connector Line: When You Care Enough to Spec the Very Best.

These hi-rel, hi-density connectors serve the military everywhere—eloquent testimony to their versatility, reliability and exclusive features.

- Highest contact density, with 110 contacts to the square inch.
- Super-sealing, with seals on the contacts in some environmental types.
- Positive polarization with our exclusive Polar-Hex center jackscrew coupling.
- MIL-C-28840 and MIL-C-55302 versions that incorporate superior design features and qualify to spec limits.
- And our MIL-C-28876 fiber optic connector, the only multi-channel type to meet mil spec.

For more information about our standard line, phone Bob Torres at 714-660-5829. In England, Hugh McInally at 932-47262.

HUGHES
AIRCRAFT COMPANY
CONNECTING DEVICES DIVISION
Industrial Electronics Group

CIRCLE NO 156

data from the RAMs to be loaded without affecting the contents of the shift register; these latches provide a means of decoupling the video RAM timing and the serializer timing. In a 24-pin plastic DIP, $20 (100).

Advanced Micro Devices Inc, Box 3453, Sunnyvale, CA 94088. Phone (408) 982-7448.

Circle No 385

LOGIC DEVICE

The PAL16RA8 programmable logic device provides both synchronous and asynchronous logic in the same part, and is a replacement for asynchronous random logic as well as asynchronous control/handshaking circuitry. The 20-pin device features individually programmable clocks, register bypassing, programmable output polarity, and outputs that you can individually configure as registered or combinatorial and active low or active high. Maximum propagation delay is 30 nsec (20 nsec typ), and maximum supply current is 170 mA. The device works with clock rates as high as 20 MHz. You can order the part in a plastic or ceramic DIP or a PLCC. $11.60 (plastic DIP); $14.50 (ceramic DIP or PLCC) (100).

Monolithic Memories Inc, 2175 Mission College Blvd, Santa Clara, CA 95054. Phone (408) 970-9700. TWX 910-338-2376.

Circle No 386

AC/DC CONVERTERS

With the aid of two external capacitors and a resistor, the MAX600 family of ac/dc converters can convert line voltages of 24, 110, or 220V ac directly to a 5V dc output voltage. Each converter is specified for 0 to 50°C operation and is housed in an 8-pin DIP. Three devices constitute the family: The MAX600 is a full-wave, line-powered device; the MAX601 is a half-wave, line-powered unit; and the MAX602 is a transformer-isolated, full-wave con-

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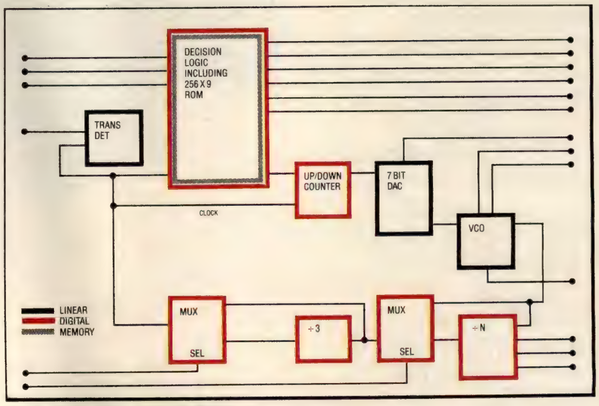
VL1000
Analog/Digital Standard Cell Library:



TYPICAL VL1000 APPLICATION

Easy-to-Use, Cell-Based Solutions for High-Performance Analog/Digital Systems.

The VL1000 features 73 analog and 106 digital and memory cells that can be integrated into single-chip designs. Its standard-cell methodology lets you concentrate on systems problems without concern for discrete IC design.

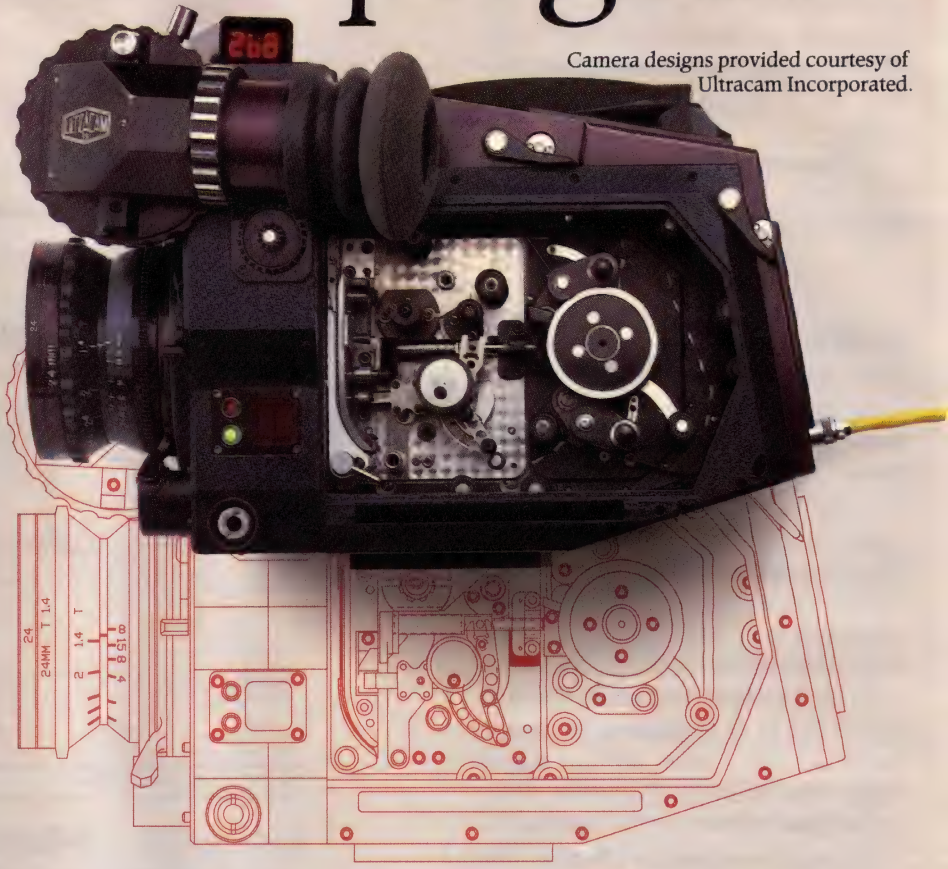
Two-layer metal and high-density cells minimize chip size and increase performance, with bandwidths to 200MHz, $1nV/\sqrt{Hz}$ noise, clock rates to 60MHz, 1.5ns internal gate delays, and typical complexities to 100 cells.

VL1000 cells include DACs to 8 bits, 741 op amp, 733 and 592 differential video amps, high-speed comparators, references, a large range of SSI and MSI digital functions, and memory cells—all fully characterized over the commercial and military temp ranges.

You can also mix high-speed TTL and 10KH I/Os on the same chip.

VTC Incorporated

Picture this on a $2,500 CAD program.



Camera designs provided courtesy of Ultracam Incorporated.

When Ultracam Incorporated set out to design the Ultracam™ K35, they knew that their design tool needed to be as professional as the camera they were designing. That's why they chose AutoCAD,™ the most widely used computer-aided design and drafting tool in the world today.

Mainframe CAD Capability at 5% of the Price

If you have an IBM PC, PC/XT, PC/AT, NEC, DEC, TI, Tandy, Wang, or one of over 30 desktop computers AutoCAD supports, you already own the most expensive part of a CAD system. Add AutoCAD for only $2500 more, and you can have the power of CAD on your desktop at a price you can afford. With a pointing device and a plotter (the choice is yours, we support over 50 popular peripherals,) you can assemble a complete CAD workstation for less than $10,000.

Once you've installed AutoCAD on your computer, you'll have a tool at your fingertips which removes the drudgery from designing.

Quick to Learn, Easy to Use

The beauty of AutoCAD is that you need no prior knowledge of computers. Even if you've never seen a CAD system, you'll pick it up in a matter of days, and feel comfortable within a week.

Simple pop-up menus point you in the right direction. You can also easily create your own menus. On-line HELP keeps you on track.

Sailboats, Landscapes, and Custom Homes

Since AutoCAD is general-purpose and user-customizable, it doesn't matter what type of drafting your work requires. Tens of thousands of AutoCAD users are creating drawings and developing designs in every discipline with ease and accuracy never experienced before.

The Heart of Your CAE System

Drawings are only part of the story. Pre-defined standard symbols, translators to allow AutoCAD to exchange drawings with mainframe CAD systems, data base analysis programs for bill of material lists, job costing and drawing distribution by telephone are only some of the capabilities available with AutoCAD. These capabilities make AutoCAD the central component in your desktop computer-aided engineering (CAE) system.

Whether you're in a two-person shop or a two-billion dollar company, you'll find that AutoCAD pays for itself in just a few months.

In the future, AutoCAD will run on newer, more powerful computers as they become available—so that you can be sure your investment in creating drawings and training staff won't be wasted.

Powerful New Capabilities

Call or write us today for the name of the dealer nearest you and a demonstration of the latest in AutoCAD capabilities, including polylines, curves, and 3D visualization with hidden line removal. Also ask about other cost-effective Autodesk products: AE/CADD™ and CAD/camera.™

AutoCAD, world leader in design and drafting software, will save you time and money.

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CIRCLE NO 157

verter. All devices feature overvoltage and undervoltage indication and programmable current limiting. The manufacturer can preprogram the converters to any output voltage between 1.3 and 9V via fuseable-link programming; this preprogramming is available at no charge for OEM orders. $0.95 (10,000).

Maxim Integrated Products, 510 N Pastoria Ave, Sunnyvale, CA 94086. Phone (408) 737-7600.

Circle No 387

CMOS RAM

This MIL-STD-38510, JAN-qualified CMOS RAM, the HM-6514 (JAN number 24502BVB), is organized as 1k×4 bits and uses a 6-transistor CMOS memory cell. The design yields high-speed performance and low current drain over the military temperature range, according to the manufacturer. This cell design also affords increased alpha-particle protection, radiation-tolerant operation, and internal cell stability. The device operates over the −55 to +125°C range, provides an access time of 120 nsec, and draws a standby current of 50 μA. It's available in an 18-pin ceramic DIP. $46.70 (1000).

Harris Corp, Semiconductor Digital Products Div, Box 883, Melbourne, FL 32901. Phone (305) 724-7800.

Circle No 388

AMPLIFIER

The OP-77 is a low-offset-voltage (10 μV type, 25 μV max) operational amplifier that provides a gain of 5,000,000 min and nearly ideal gain linearity. Common-mode and power-supply rejection ratios are 1.0 μV/V and 3 μV/V max, respectively. The op amp requires less than 2 mA of supply current and has virtually no gain nonlinearity. It's available in a TO-99 enclosure and an 8-pin DIP. Commercial-grade version, $1.50; industrial version,

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VL2000
Digital Standard Cell Library:

VL2000 POWER, SPEED, FLEXIBILITY COMPARISON	*VTC VL2000*	*Motorola MCA2500*	*AMCC Q3500S*	*NEC UPB6310*
Methodology	Std. Cell	Gate Array	Gate Array	Gate Array
No. of I/O Cells	Unlimited	120	120	180
ECL I/Os?	Y	Y	Y	Y
TTL I/Os?	Y	N	Y	N
Speed/Power Product* (pJ/gate)	0.6	0.75	1.1	1.1
Max. Toggle Freq., MHz	500	400	400	200
Number of Gates	Variable	Fixed	Fixed	Fixed
Internal Prop. Delays (FO = 2, 1mm metal), nsec	0.35	0.25	0.5	1.0
Maximum Output Current (mA)	48	NA	20	NA
Power Supply Range	−5.2 to 5.0 ±10%	−5.2 ±10%	5.25	−5.2 ±10%
Temperature Range	Military	Commercial	Military	Commercial

Source: **EDN** *Semicustom IC Directory, 1985. *Calculated from source data.*

Ultra High-Speed Logic Functions, with Unlimited I/O Flexibility.

The VL2000 is the fastest digital standard cell ASIC solution on the market today... with 350ps gate delays. Its 2-micron, oxide-isolated bipolar process allows single-chip complexities of up to 5000 gates.

The VL2000 library includes 78 digital logic and memory cells, including SSI and MSI functions, 13 different ECL and TTL I/Os (which can be mixed), a 9-bit parity generator/checker, a 16x4 dual-port RAM, a priority interrupt encoder, and a 2901 4-bit ALU.

Most of the VL2000's cells provide a choice of two speed/power levels, and typically 50% less power is required than similar-sized ECL gate arrays.

The VL2000's cells are characterized over the mil temp range, with demonstrated radiation hardening to one megarad.

VTC Incorporated

SLOW TODAY, GONE TOMORROW.

In this business, it's not enough just to keep up. You and your system have to be fast. Fast in performance. Fast to market.

And that's where Adaptec can help.

We offer a family of controller chips with unusual flexibility. And unmistakable speed.

Our AIC-010 mass storage controller chip is a perfect example. It's fully programmable, runs up to 24 MHz, and works with any host and any storage device. Winchester, tape and even optical disk.

We also have other chips that help in other ways. Like encoder/decoders, a dual-port buffer controller, fully-integrated VCO and a SCSI chip. So you can choose just the features you need, and forget about the ones you don't.

What you'll end up with are faster data transfer rates, a faster time to market, and the best possible performance.

So for a brochure, give us a call at 408/946-8600, ext. 400. Or write Adaptec, 580 Cottonwood Drive, Milpitas, CA 95035.

And wave goodbye to your competition.

adaptec

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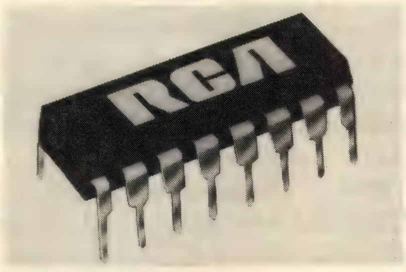
$2.10; military-temperature version, $13.50; military 883C-grade version, $16.75 (100).

Precision Monolithics Inc, Box 58020, Santa Clara, CA 95052. Phone (408) 727-9222. TLX 172070.

Circle No 389



BCD COUNTER

The CD4522B, a member of the CD4000B Series, is a programmable divide-by-n counter with BCD outputs. It operates synchronously with the clock pulse and uses an edge-clocked design: A positive-going edge on the clock input or a negative-going edge on the clock-inhibit input increments the counter. As with all CD4000B Series devices, it operates with supply voltages as high as 20V. You can configure the CD4522B to perform single- or multiple-counter operations. In single-stage operation, the chip's decoded low-state output is tied to the preset-enable input. In multiple-counter designs, the chip offers a cascaded feedback output that permits multiple-stage divide-by-n counting without the need for external gating circuits. Maximum input current over the full temperature range at a supply voltage of 18V is 1 μA. At room temperature (25°C), input current is typically 100 nA. The CMOS counter conforms to the requirements of JEDEC Standard 13B. In a plastic package, it costs $1.49 (100).

RCA, Solid State Div, Box 2900, Somerville, NJ 08876. Phone (201) 685-6104.

INQUIRE DIRECT

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FOR REAL ASIC PERFORMANCE, COME TO VTC . . . THE BIPOLAR ASIC LEADER.

No one else can offer you the selection and performance you get with VTC's *BasicASIC*™ family.

It's quite simple: with VTC, you not only get the highest performance and most advanced, field-proven technology. We also give you the *basic tools* and *basic training* to get the job done. Including unmatched design and applications engineering support . . . CAD support . . . regional design centers . . . technical seminars . . . and Design Systems with all necessary software and documentation for fast and reliable turnaround of designs on workstations, including the PC AT.

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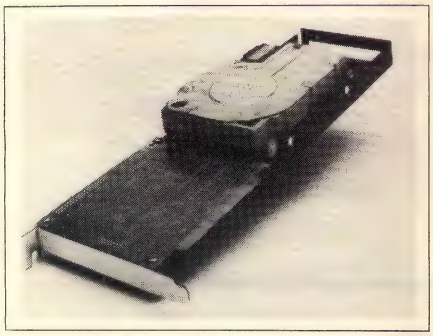
VTC Incorporated
On the Silicon Frontier.™

CIRCLE NO 155

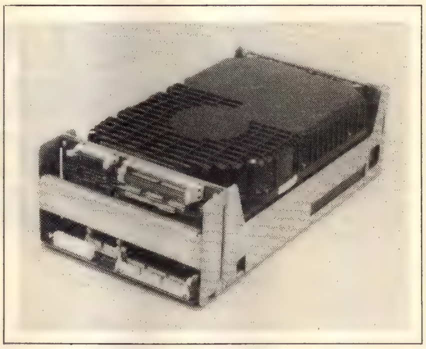


DISK CARD

Featuring a card-mounted 3½-in. Winchester disk drive, the Diskard 21 lets you add 21.3M bytes of formatted storage capacity to your IBM PC, PC/XT, or compatible computer. The device requires one full slot. Using plated media and consuming 11W, the board operates with PC-DOS and MS-DOS 2.0 (and later versions). The device requires no accessory boards, cables, or installation software. The disk card includes a dedicated parking zone (where the head resides when it's not reading data) and a temperature-compensated, closed-loop positioning system. Approximately $995.

Tandon Corp, 20320 Prairie St, Chatsworth, CA 91311. Phone (818) 993-6644. TWX 910-493-5965.

Circle No 391



HARD-DISK DRIVE

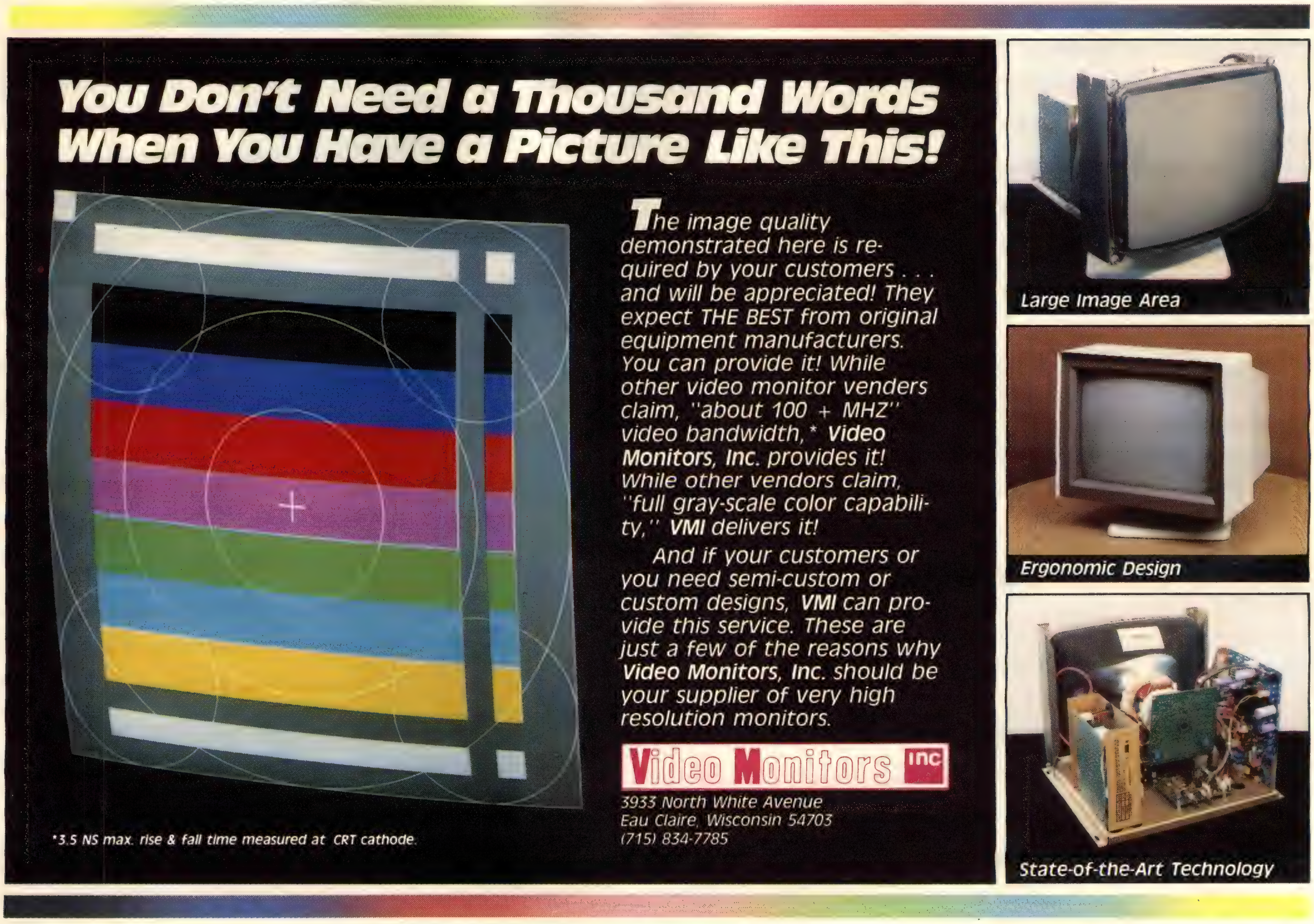
Featuring a thin-film head for high storage capacity, the DX548 hard-disk drive includes an interface for a 14.52-MHz data-transfer rate. Using Whitney heads, this drive offers a higher bit and track density than drives with Winchester heads. A dual-port interface is optional. The unit consumes 155W and has an average access time of 20 msec and a track-to-track seek time of 4 msec. It measures 4.62×8.55×16.06 in. and thus fits into a slot that accommodates an 8-in. floppy-disk drive. The 548M-byte drive uses a direct-drive, dc-brushless spindle motor; includes a self-calibrating actuator; and requires no adjustments or preventive maintenance. $5300 (250).

Pertec Peripherals Corp, Box 2198, Chatsworth, CA 91311. Phone (818) 882-0030. TWX 910-494-2093.

Circle No 392

PC-LAN LINK

When fitted with these LAN cards, DEC minicomputers can communicate with IBM PC/XT, PC/AT, and compatible computers over the man-



You Don't Need a Thousand Words When You Have a Picture Like This!

The image quality demonstrated here is required by your customers . . . and will be appreciated! They expect THE BEST from original equipment manufacturers. You can provide it! While other video monitor venders claim, "about 100 + MHZ" video bandwidth,* **Video Monitors, Inc.** provides it! While other vendors claim, "full gray-scale color capability," **VMI** delivers it!

And if your customers or you need semi-custom or custom designs, **VMI** can provide this service. These are just a few of the reasons why **Video Monitors, Inc.** should be your supplier of very high resolution monitors.

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Eau Claire, Wisconsin 54703
(715) 834-7785

*3.5 NS max. rise & fall time measured at CRT cathode.

Large Image Area

Ergonomic Design

State-of-the-Art Technology

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VMEbus technology takes two more giant strides.

Mizar Inc., one of the first to offer a VMEbus board and the first with a complete line of VMEbus single-height boards, leads the industry again with two more important VME firsts:

The Intelligent VME7400 – the only disk controller capable of transferring one track in one revolution.

The Memorable VME7200 – the first double-height memory board with PLCC technology to provide up to four megabytes of dynamic RAM.

Intelligent. Memorable. No wonder more and more people are making Mizar their logical first choice for VMEbus boards, systems, software. . . and service. Mizar the VMEbus authority. First again. And again.

The VMEbus authority.™

MIZAR INC.
20 Yorkton Court
St. Paul, MN 55117
612-224-8941
TELEX 469542

For complete information about Mizar and our product line, please complete and return the coupon below or call Mizar Inc.: 612-224-8941.

TO: Mizar Inc.
20 Yorkton Court
St. Paul, MN 55117

Please send me information about your product line including the new VME7400 ST-506 Disk Controller and the new VME7200 Memory Board with surface mounted memory.

NAME ______
POSITION ______
FIRM ______
ADDRESS ______
CITY ______ STATE ______ ZIP ______
PHONE ______

CIRCLE NO 160

ufacturer's Omninet LAN. The DQZ card plugs into Q Bus computers, including the MicroVAX; the DUZ attaches to such Unibus computers as the VAX 11/750. The DQZ, which emulates DEC's DZV11 multiplexer, communicates with four PCs simultaneously over a network as long as 4000 ft. You can connect as many as 60 PCs to the LAN for communication with the DQZ. The DUZ emulates three DEC DZ11 multiplexers and contains three ports; each port can connect to 60 PCs, allowing the DUZ to communicate with 24 users simultaneously. PCs on the network require the vendor's Omninet interface card and VT100 emulation and file-transfer software. With EM100 network license, the DQZ and DUZ cost $2795 and $6395, respectively.

Corvus Systems Inc, 2100 Corvus Dr, San Jose, CA 95124. Phone (408) 559-7000. TLX 278976.

Circle No 393

PC HARD-DISK CARD

You can add 22M bytes of hard-disk storage to your IBM PC or compatible computer by plugging the Scorecard into one of the PC's expansion slots. The card's controller provides direct system booting and closed-loop head positioning. Average access time is 80 msec. The card includes an ST-506/ST412 port to which you can attach a second internal or external disk drive. With a 1-year warranty, $895.

Systems Peripherals Consultants, 9747 Business Park Ave, San Diego, CA 92131. Phone (619) 693-8611.

Circle No 394

INTERFACE CARD

The Model A-STD 65280 interface card system hooks an Apple IIe to the STD Bus. It includes a board that plugs into the Apple, an STD Bus board, a ribbon cable to connect the boards, and software on a floppy disk. By translating read/write con-

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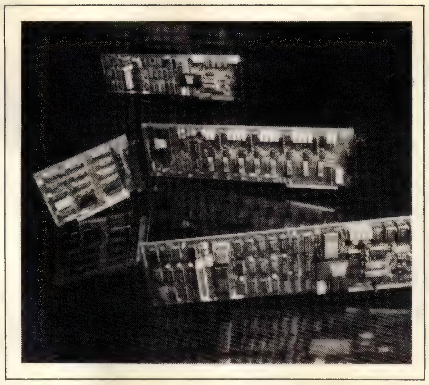
ventions between the 6502-based computer and the Z80-type STD Bus, the system enables the computer to communicate with and control devices on the bus. With an operating manual and a 1-year limited warranty, $595.

Applied Science Laboratories, 335 Bear Hill Rd, Waltham, MA 02154. Phone (617) 890-5100.

Circle No 395



I/O BOARDS

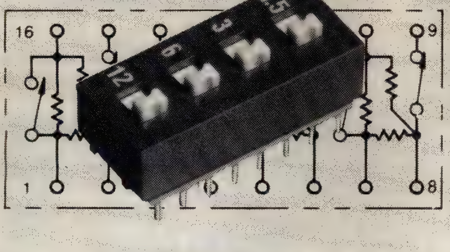
RTI-800 Series I/O boards come with I/O software routines that you can call from such languages as Basic, BasicA, Lattice C, Pascal, Fortran, and Turbo Pascal. The boards provide as many as 32 single-ended analog input channels. The software controls such functions as analog and digital I/O, pulse outputs, and frequency and event counting. The RTI-815 provides 16 single-ended or eight differential analog inputs along with two analog outputs, 16 digital I/O lines, and three frequency/timer channels. The device performs 12-bit A/D conversions in 25 μsec (typ); a high-speed option provides 12- or 8-μsec conversions. Except for the lack of analog output, the RTI-800 offers the same features as the RTI-815. The RTI-802 provides four or eight analog output channels and features 12-bit A/D resolution. The RTI-817 features 24 channels of digital I/O. RTI-800, $850; RTI-802, with four analog outputs, $695; RTI-815, $1095; RTI-817, $295. A PC-DOS driver package, including Basic, Pascal, BasicA, Lattice C, and Fortran, $195; Turbo Pascal package, $295.

Analog Devices, Literature Center, 70 Shawmut Rd, Canton, MA 02021. Phone (617) 461-3565. TWX 710-394-6577.

Circle No 396

32032 PC SUBSYSTEM

The 532.32 coprocessor system for the IBM PC/XT and PC/AT contains the 32032 32-bit μP. The system, with 1M or 2M bytes of RAM, occupies one PC expansion slot; a 4M-byte version takes up two slots. The board comes with a version of AT&T's Unix System V (release 2, version 2) and compilers for C and Fortran. An assembler and debugger are standard; AT&T Pascal, a Basic compiler, and an implementa-



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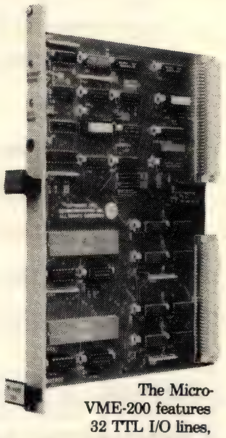
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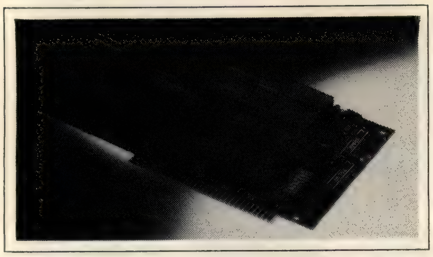


tion of Cobol are optional. With 2M bytes of memory, less than $3000 (OEM qty). Delivery, 30 to 60 days ARO.

Opus Systems, 20863 Stevens Creek Blvd, Bldg B4, Cupertino, CA 95014. Phone (408) 941-7201.

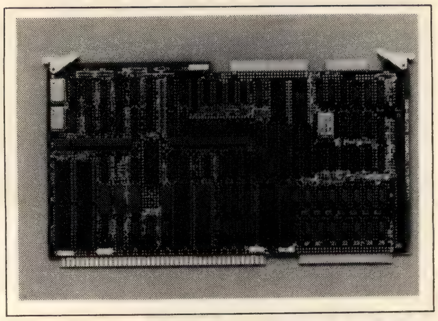
Circle No 397

STORAGE SUBSYSTEMS

Units in the Twister Series of Winchester-drive systems fit inside the BA23 chassis used in DEC MicroVAX and MicroPDP-11 computers, increasing the computers' storage capacity by as much as 320M bytes. In addition to the disk drive, each subsystem includes a diagnostic panel, mounting hardware, and a controller. The disk drives offer an average access time of 27 msec and noninterleaved data transfers. The controller automatically converts data between the disk drive's and the Q Bus's protocol. $6195 (120M-byte system) to $11,995 (320M-byte system).

Qualogy, 2241 Lundy Ave, San Jose, CA 95131. Phone (408) 946-5800. TWX 910-338-0249.

Circle No 398



8086 MULTIBUS CPU

The DSB-86/37A Multibus board contains an 8-MHz 8086 µP, so it can run software written for Intel iSBC-86 single-board computers. The board includes 128k bytes of RAM that the 8086 accesses with no wait states. You can install as much as 128k bytes of EPROM in sockets on the board. An 8251A chip implements an RS-232C interface, and an 8255A chip connects to 24 parallel I/O lines. Two iSBX connectors attach to iSBX peripherals. The board includes an 8259A programmable interrupt controller and an 8253 programmable interval timer. You can add an 8087 numeric coprocessor and an 8089 DMA coprocessor. A 2-year warranty and free 24-hour replacement service are included. $551 (100).

Pascot Inc, Densan Div, 17981 Skypark Circle, Suite B, Irvine, CA 92714. Phone (714) 261-5220.

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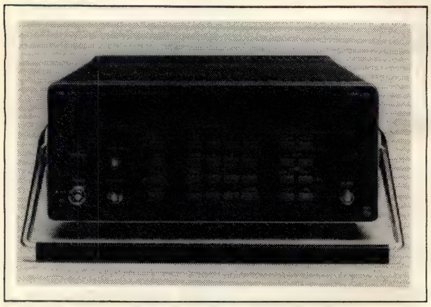


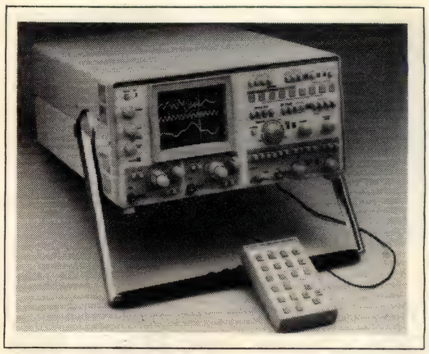
RF SYNTHESIZER

The PM 5390S is a programmable, 1-GHz RF synthesizer providing internal and external AM and FM as well as video modulation. The unit offers an output of 100 kHz to 1020 MHz and digital selection and display of frequency, signal amplitude, frequency increment, and sweep time. In addition, it has a built-in IEEE-488 interface. The instrument offers AM modulation over its 1-GHz range, and FM modulation as high as 340 MHz. You can control the sweep either internally or externally in single-sweep or continuous mode, and you can vary the sweep rate from 50 msec to 20 sec. Two versions are available: the PM 5390 with open-circuit RF amplitude variable from 0.2 μV to 200 mV (-127 to -7 dBm), and the PM 5390S, offering a 2V max open-circuit RF amplitude (13 dBm). Time-base stability is $\pm 1 \times 10^{-6}$. Output harmonic distortion is less than 30 dB; nonharmonic distortion is less than 40 dB. PM 5390S, $6425.

Philips Test & Measuring Instruments Inc, 85 McKee Dr, Mahwah, NJ 07430. Phone (201) 529-3800.

Circle No 400

DIGITAL SCOPE



The Model 4050 digital storage oscilloscope (DSO) has dual-channel, 100-MHz A/D converters, 8-bit vertical resolution, 1k byte of sample memory per channel, 5-trace nonvolatile RAM, and an IEEE-488 interface. In addition, it features on-screen cursors and optional signal processing. The DSO also functions as a dual-channel, 35-MHz analog oscilloscope. Using the optional TI35 keypad, the scope can perform filtering, signal averaging, waveform comparison, TV-line capture, and interchannel math operations. The instrument's filtering capability includes six selectable lowpass filters for each time-base setting. By using channel arithmetic functions, you can achieve highpass-, bandpass-, and notch-filter characteris-

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tics. Approximately 840 combinations are available, and you can apply signal averaging to as many as 256 events. $7950; without optional keypad, $7290. Delivery, 60 days ARO.

Gould Inc, Recording Systems Div, 3631 Perkins Ave, Cleveland, OH 44114. Phone (216) 361-3315.

Circle No 401

µP SOFTWARE

The Validate µP development software contains a source-level debugger that works with Pascal and C languages on Unix and VMS systems. VAX, MicroVAX, Sun, Apollo, and compatible computers can run the software. In addition, the software supports in-circuit emulators for the 68000, 68008, 68010, 8086, 8088, 80186, and 80188 µPs. Each system also includes a cross compiler and assembler, and optionally, a workstation host. From $22,000.

Applied Microsystems Corp, 5020 148th Ave NE, C-1002, Redmond, WA 98052. Phone (800) 426-3925; in WA, (206) 882-2000. TLX 15247.

Circle No 402

OSCILLOGRAPH

The MT-8500 8-channel oscillographic recorder records eight analog signals on thermal paper in real time at frequencies to 500 Hz and amplitudes to 200 mm with flat response. The channel-expansion feature allows the oscillograph to expand one or more waveform channels automatically or on command; this feature provides visual analysis of selected portions of a recording. The unit can record 2-kHz events in transient-capture mode as well as alphanumerics and graphics. According to the manufacturer, this is the first oscillographic recorder that can plot any two channels of data in an X-Y format as well as an X-T format. When used with the optional IBM PC, the device can record as many as 30 channels of digitized data. The unit weighs 38 lbs and is 8¾ in. high. It accepts a family of plug-in signal conditioners. Chart speeds range from 1 mm/hour to 100 mm/sec in 1-mm increments. $8200, recorder and software.

Astro-Med Inc, Astro-Med Industrial Park, West Warwick, RI 02893. Phone (800) 343-4039. TWX 710-382-6409.

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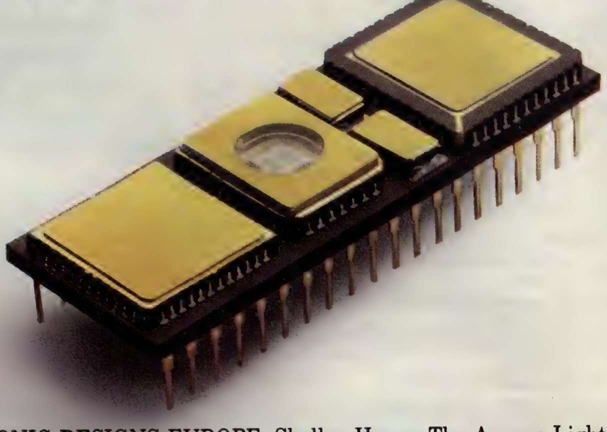


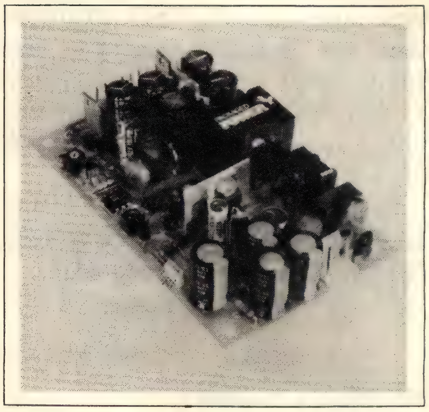
COUNTER/TIMER

The Model 775 counter/timer features two identical input channels that measure from dc to 120 MHz and resolution to nine digits/sec over the entire frequency range. The unit measures pulse width to 10-nsec resolution, cross-channel time interval, period, and period average. An IEEE-488 interface is included. You can program the trigger levels of both channels over the IEEE-488 bus. An alarm sounds when the desired signal level is found. Gate time is 10 μsec to 10 sec, selectable in 45 increments. You can program the delay function from 100 μsec to 10 sec for measuring relay open, close, and bounce times; pulse trains; and signal bursts. By adding a third channel, you can extend frequency-range measurements from 50 MHz to 1 GHz. $1495; 3-channel version with temperature-compensated crystal oscillator, $1895.

Keithley Instruments Inc, 28775 Aurora Rd, Cleveland, OH 44139. Phone (216) 248-0400. TLX 985469.

Circle No 404

40W SWITCHERS



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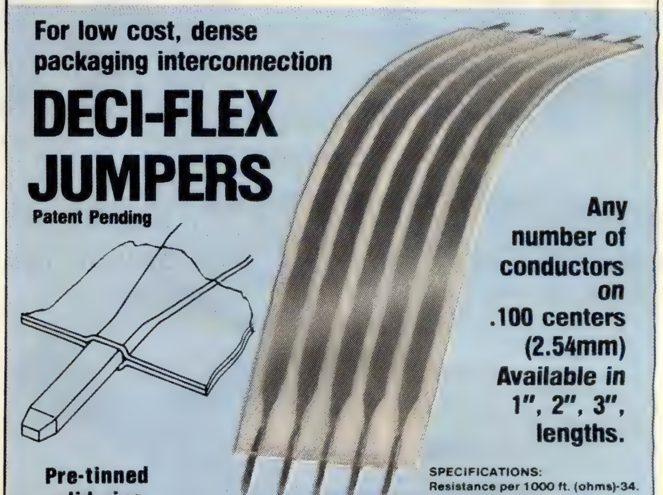

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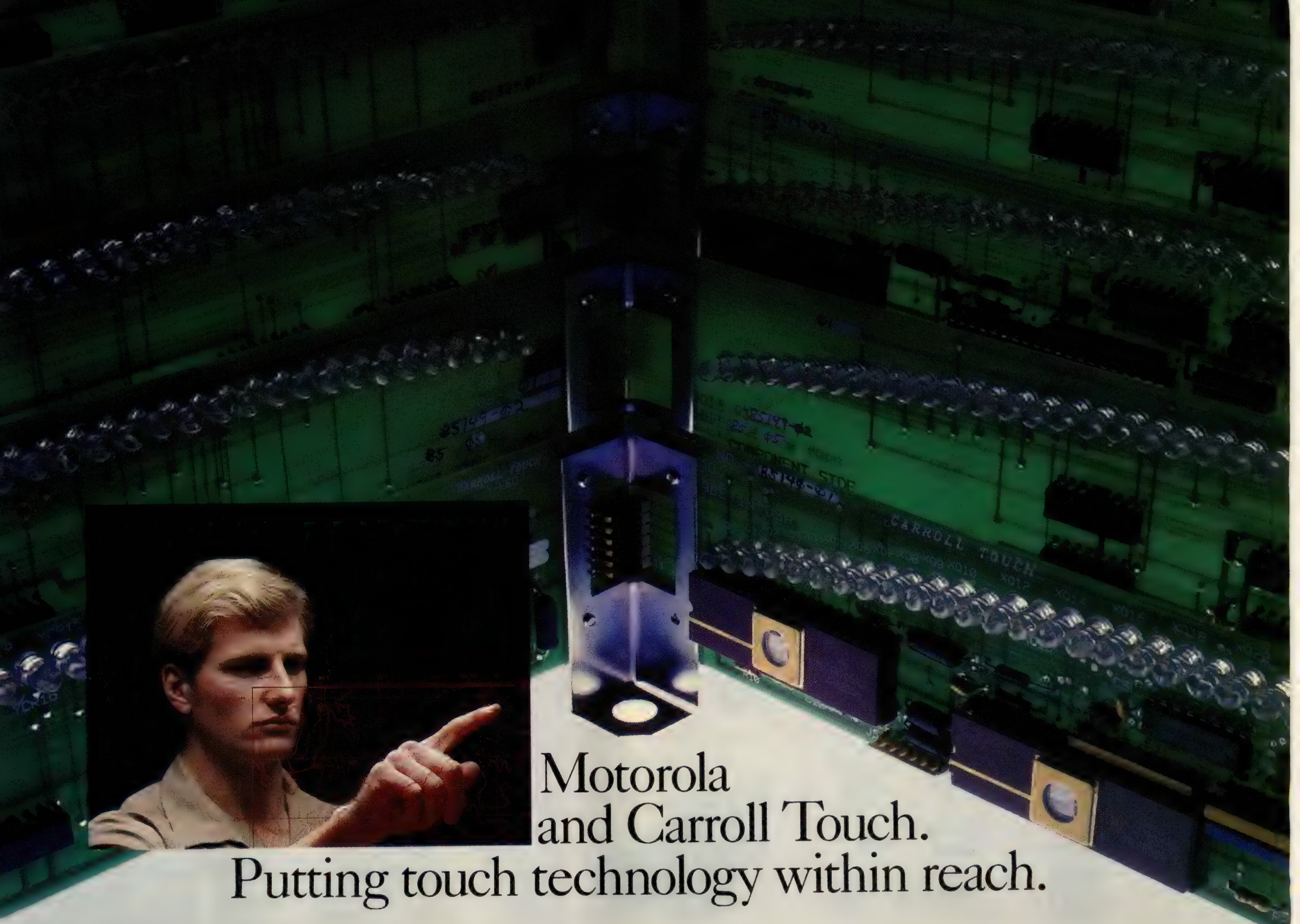

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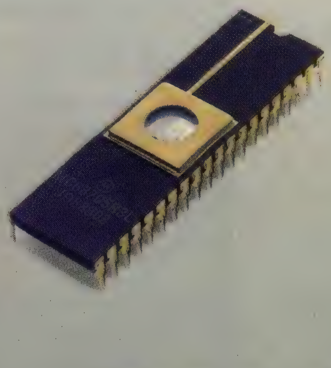

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CIRCLE NO 164

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Computer Products Inc, Power Conversion Group, 2900 Gateway Dr, Pompano Beach, FL 33069. Phone (408) 942-1600. TLX 172760.

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SYNTHESIZER

The PM 5193 0.1- to 50-MHz frequency synthesizer/function generator provides eight different waveforms, including sine, square, triangular, ramp, haversine, and pulses. Transition time for a pulse's edges is 3 nsec. Modulation facilities include internal/external AM from 0 to 200 kHz, with modulation depth programmable from 0 to 100%; internal/external FM from 10 Hz to 200 kHz; internal/external gating from 10 Hz to 200 kHz; and linear and logarithmic sweep over the 11½-decade frequency range. For use with an IEEE-488 bus controller, the generator will respond with an identification message for instrument type and software version. It executes the IEEE-488 SRQ command and has a bus-learn mode. $4595. Delivery, two to eight weeks ARO.

Philips Test & Measuring Instruments Inc, 85 McKee Dr, Mahwah, NJ 07430. Phone (201) 529-3800. TWX 710-988-5348.

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AESTHETIC-FUNCTIONAL DESIGN: Outer shell and back nut finished with matte chrome plating. Contacts are gold plated.

RUGGEDNESS: Connector components are precision machined from brass bar and tubing stock and plated with copper, nickel and chrome. Locking mechanism is totally protected by outer shell, virtually eliminating accidental disconnections and damage to locking mechanism, cables and contacts. A series of O rings and gaskets provide a secure water resistant seal.

Over $1 million inventory stocked in Santa Rosa, California, sold by a network of representatives in North America.

For technical data and catalog, as well as the name of your local representative, please call or write LEMO U.S.A., INC. (707) 578-8811, TELEX 340-933, P.O. Box 11006, Santa Rosa, California 95406.

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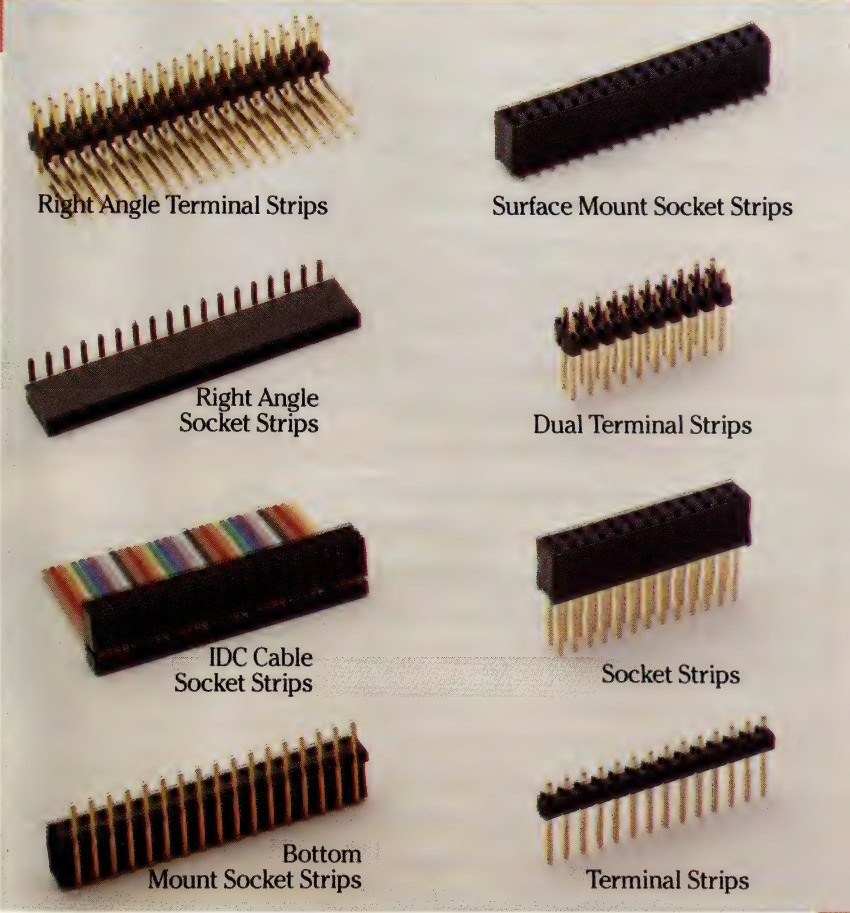
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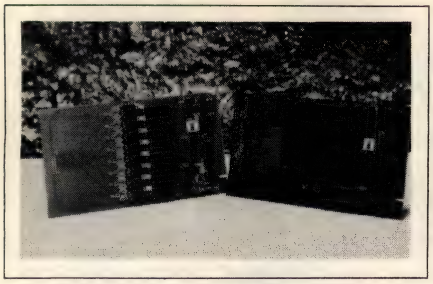


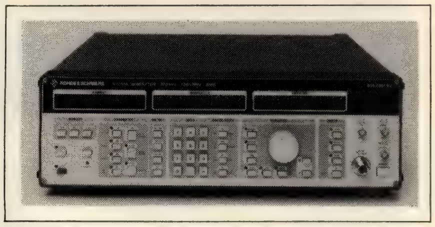
ANALOG I/O CARDS

The ADQ-1 and DA-12 cards provide 12-bit-resolution A/D and D/A conversion, respectively, and are compatible with the company's Z80A-based industrial and scientific computer systems. The ADQ-1 has a single channel ±10V input that it can sample at speeds as high as 100,000 samples/sec. The board also contains 32k bytes of RAM for data storage and a programmable sample-rate generator, which you can start and stop under software control or via external logic inputs. The ADQ-1 is available in two versions with settling times of 2 or 6 µsec. A/D-converter linearity is ½ LSB, and accuracy is 1 LSB. The DA-12 card provides eight independent ±10V analog outputs with a linearity of 1 LSB. You can modify the D/A's reference voltage to obtain other output ranges. Both cards measure 114×203 mm and mount in standard 3U×19-in. racks. The 2-µsec version of ADQ-1, £695; the 6-µsec version of ADQ-1, £495; DA-12, £345.

Kemitron Ltd, Hawarden Industrial Park, Manor Lane, Deeside, Clwyd CH5 3PP, UK. Phone (0244) 536123. TLX 61471.

Circle No 408

SIGNAL GENERATOR



The SMG signal generator produces crystal-referenced frequency outputs from 100 kHz to 1 GHz. Resolution is 1 Hz. You can adjust the output level between −137 and +13 dBm; a 16-dBm output is available for special applications. The total level error down to −127 dBm is less than 1.5 dB. Settling time after frequency or amplitude changes is <15 msec. The unit provides high-frequency stability and resolution, residual FM of <1 Hz at 250 MHz, and sweep-frequency operation with phase-continuous frequency changes for taking measurements on narrowband equipment and SSB receivers. The generator allows you to amplitude, frequency, phase, pulse, or FSK modulate the output. You can replace the standard internal modulation source, which provides eight fixed-modulation frequencies, with an optional 10-Hz to 100-kHz AF modulation source; this

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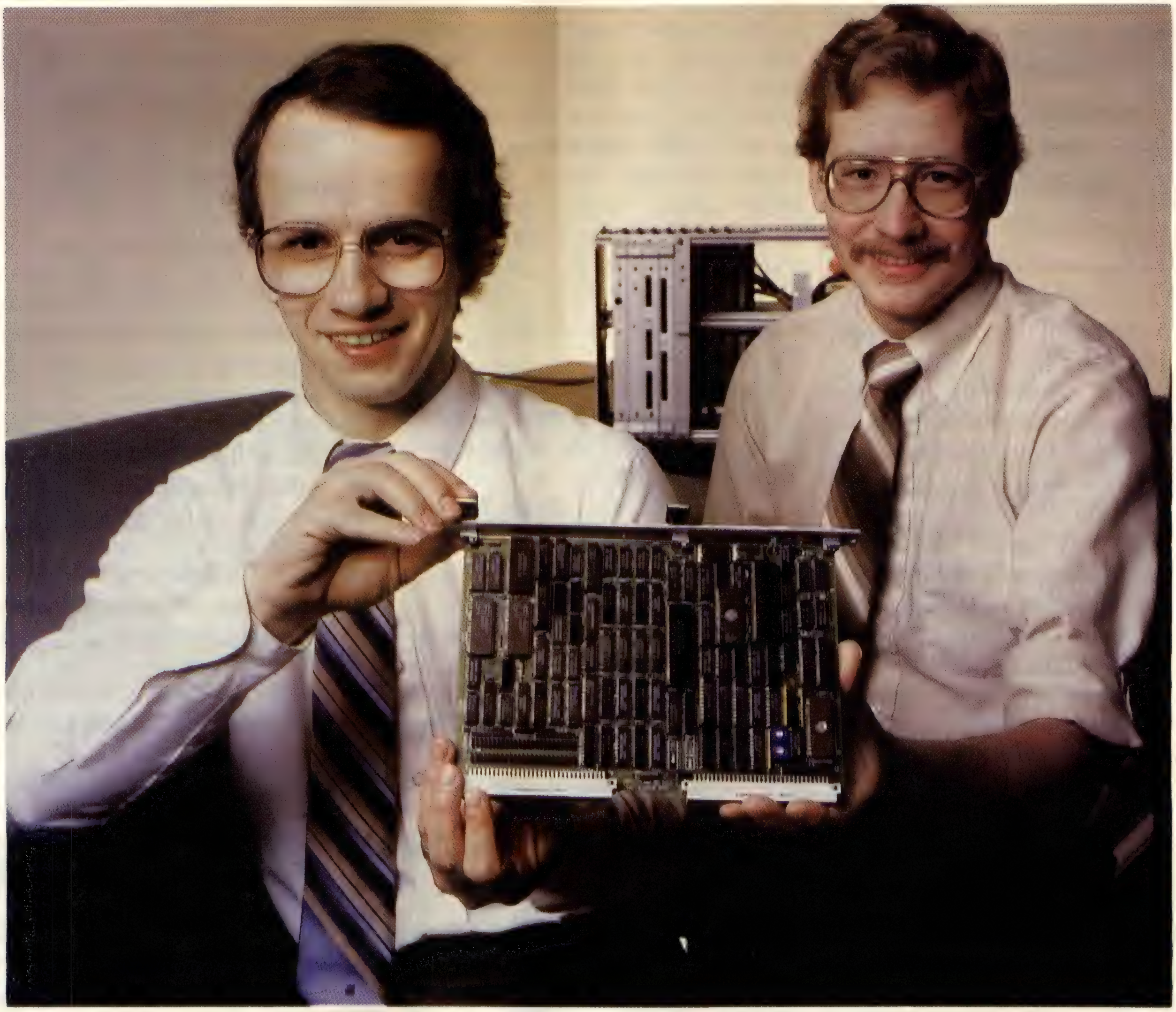

Tapemaster 3000 design engineers Bob Simning and Larry Hull

WE RESPONDED WITH THE TAPEMASTER 3000

From our unequalled experience as the leading supplier of Multibus compatible half inch tape controllers, we developed a new controller architecture for the VMEbus. We call it the "Dual-ranked FIFO."

The Dual-ranked FIFO is comprised of a 4 Kbyte Data FIFO and a proprietary, VLSI based, 32 byte Short Burst FIFO. The 4 Kbyte Data FIFO is coupled to the tape interface through a 2-level pipeline that enables read/write data rates up to 2 Mbytes/second. The 32 byte Short Burst FIFO links the Data FIFO to the VMEbus and is designed to attain burst transfer rates greater than 10 Mbytes/second.

With this architecture we've given you the ability to operate the slowest start/stop to the fastest GCR caching tape drives at maximum efficiency on the VMEbus. You've asked us for the highest performance products possible. At Ciprico we listen . . . and respond.

Other Tapemaster 3000 features include:

- 32 bit addressing, 8, 16, or 32 bit data transfers
- Programmable interrupt level and interrupt vector
- Hardware byte-order swapping
- Supports pass-through commands with optional parameters to support vendor-unique features
- Three cable exit options: through P2, from on-board connector, or through additional face-plate
- Scatter Read/Gather Write
- Reads or writes tape records of unknown and unlimited record length
- Device drivers for many operating systems including UNIX V and UNIX BSD 4.2
- Companion board to the Ciprico Rimfire 3200 VMEbus SMD-E disk controller

For information about our full line of Rimfire and Tapemaster products contact us at the following locations:

Ciprico Inc.
2955 Xenium Lane
Plymouth, MN 55441
612/559-2034

European Office:
United Kingdom
Phone (0276) 682-149
Telex: 858306

CIPRICO

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option provides a variable-amplitude audio-frequency output for external application. Approximately DM 21,000.

Rohde & Schwarz GmbH & Co KG, Mühldorfstr 15, 8000 Munich 80, West Germany. Phone (089) 41292625. TLX 523703.

Circle No 409

Rohde & Schwarz Inc, 13 Nevada Dr, Lake Success, NY 11042. Phone (516) 488-7300.

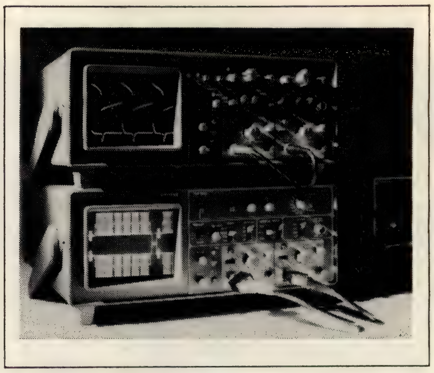
Circle No 410

OSCILLOSCOPE

Featuring double isolation of all internal circuitry, isolated input connectors, and battery-powered operation, the OX-709 oscilloscope works in military environments. The dual-channel, 30-MHz scope has a high-luminance CRT and an internal 8×10 division graticule. The scope measures 117×227×360 mm and weighs approximately 7.5 kg. Vertical input sensitivity ranges from 10 mV/div to 5V/div at 30-MHz bandwidth; ranges of 1, 2, and 5 mV/div are available at reduced bandwidths. In X/Y mode, the horizontal amplifier has a bandwidth from dc to 1 MHz. Available time-base ranges are 0.5 μsec/div to 0.2 sec/div. Internal and external triggering are provided; the unit can trigger on positive or negative TV sync pulses. It operates from 95 to 260V, 48 to 440 Hz ac line inputs, and from 10 to 36V dc supplies. You can also operate it for as long as four hours on its internal rechargeable batteries. It suits GAM T4 environments and meets Class II safety requirements. Approximately Fr fr 9000.

ITT Metrix, Chemin de la Croix-Rouge, BP 30, 74010 Annecy Cedex, France. Phone (50) 528102. TLX 385131.

Circle No 411



OSCILLOSCOPES

Models D1010 and D1011 are portable dual-trace 20-MHz oscilloscopes that feature automatic screen focusing. Vertical sensitivity on both

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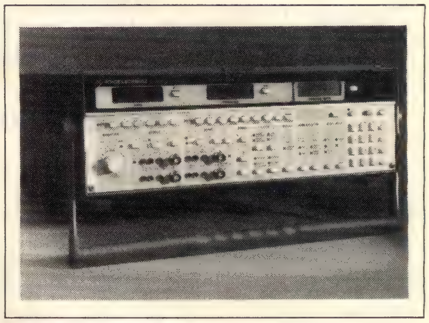
scopes ranges from 5 mV/cm to 20V/cm. You can invert either trace, allowing you to view sum and difference waveforms or display X/Y-mode waveforms in their correct quadrants. In X/Y mode, you can drive the X axis at frequencies as high as 0.5 MHz with a sensitivity of 2 mV. The D1010 has one time base with ranges between 0.5 μsec/cm and 0.2 sec/cm as well as ×10 expansion capability. The D1011 is a dual-time-base version with manual or automatic A-time-base ranging and a delayed B time base that you can operate in free-run or triggered modes. D1010, DM 995; D1011, DM 1580.

Siemens AG, Zentralstelle für Information, Postfach 103, 8000 Munich 1, West Germany. Phone (089) 2340. TLX 5210025.

Circle No 413

Siemens Components Inc, 186 Wood Ave S, Iselin, NJ 08830. Phone (201) 321-3400.

Circle No 414



AUDIO ANALYZER

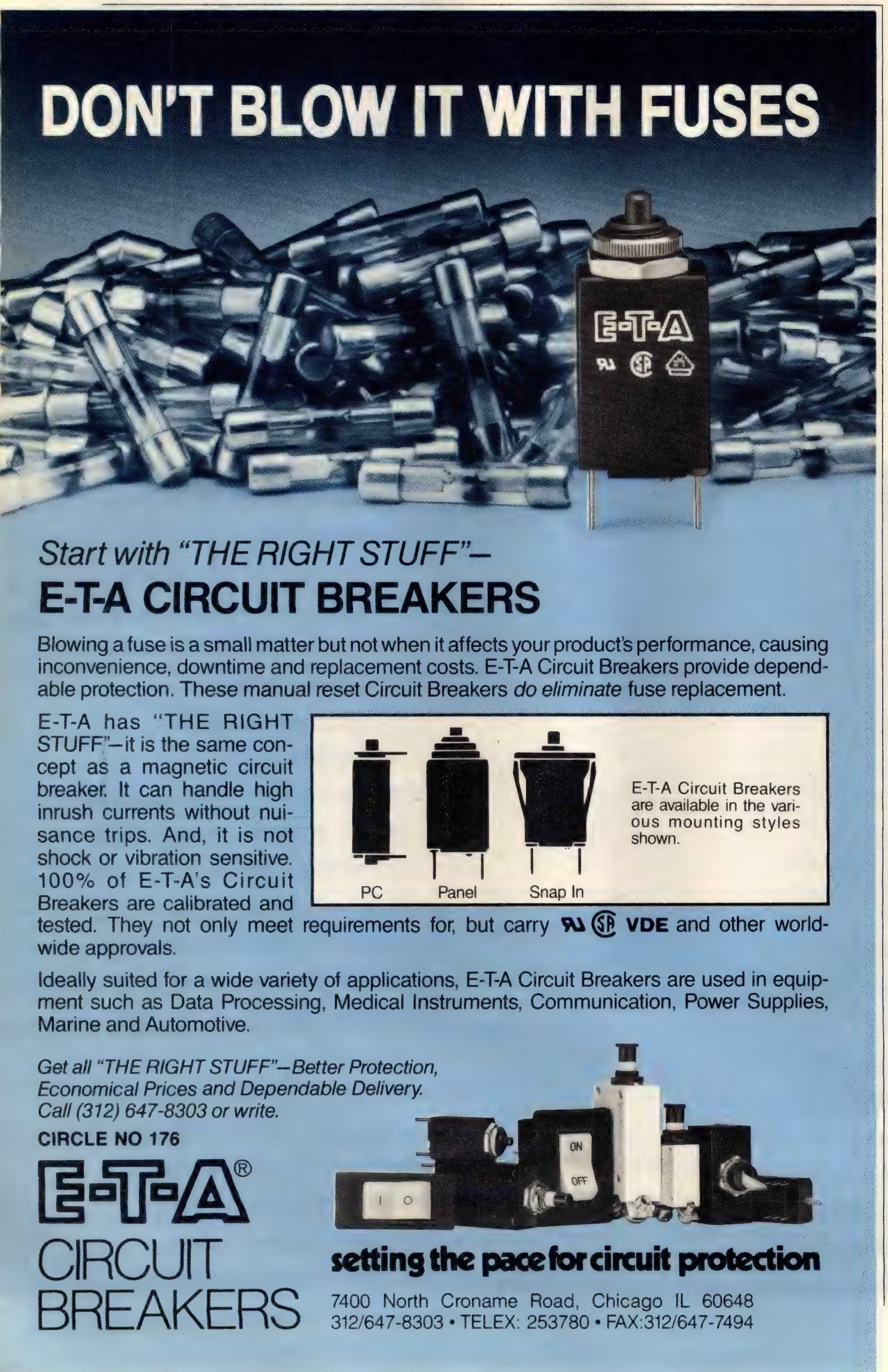
The basic unit of the UPA audio analyzer consists of a broadband signal-level meter and psophometer equipped with an integrated frequency counter. You can add a synthesized signal generator, a distortion meter, and wow and flutter meters as options to form an audio test system. For automated systems, you can control the unit via the IEEE-488 bus. The analyzer is equipped with selectable highpass and lowpass filters, as well as weighting filters and rectifiers to provide psophometric measurements according to DIN 45405, CCIR, and CCITT standards. The level meter has a measurement range of 10 μV to 300V on its unbalanced inputs, and 10 μV to 35V on its balanced inputs. Analyzer, DM 14,600; sine-wave generator, DM 3780; distortion meter, DM 3050; wow and flutter meter, DM 1790.

Rohde & Schwarz GmbH, Mühldorfstr 15, 8000 Munich 80, West Germany. Phone (089) 41292625. TLX 523703.

Circle No 415

Rohde & Schwarz Inc, 13 Nevada Dr, Lake Success, NY 11042. Phone (516) 488-7300.

Circle No 416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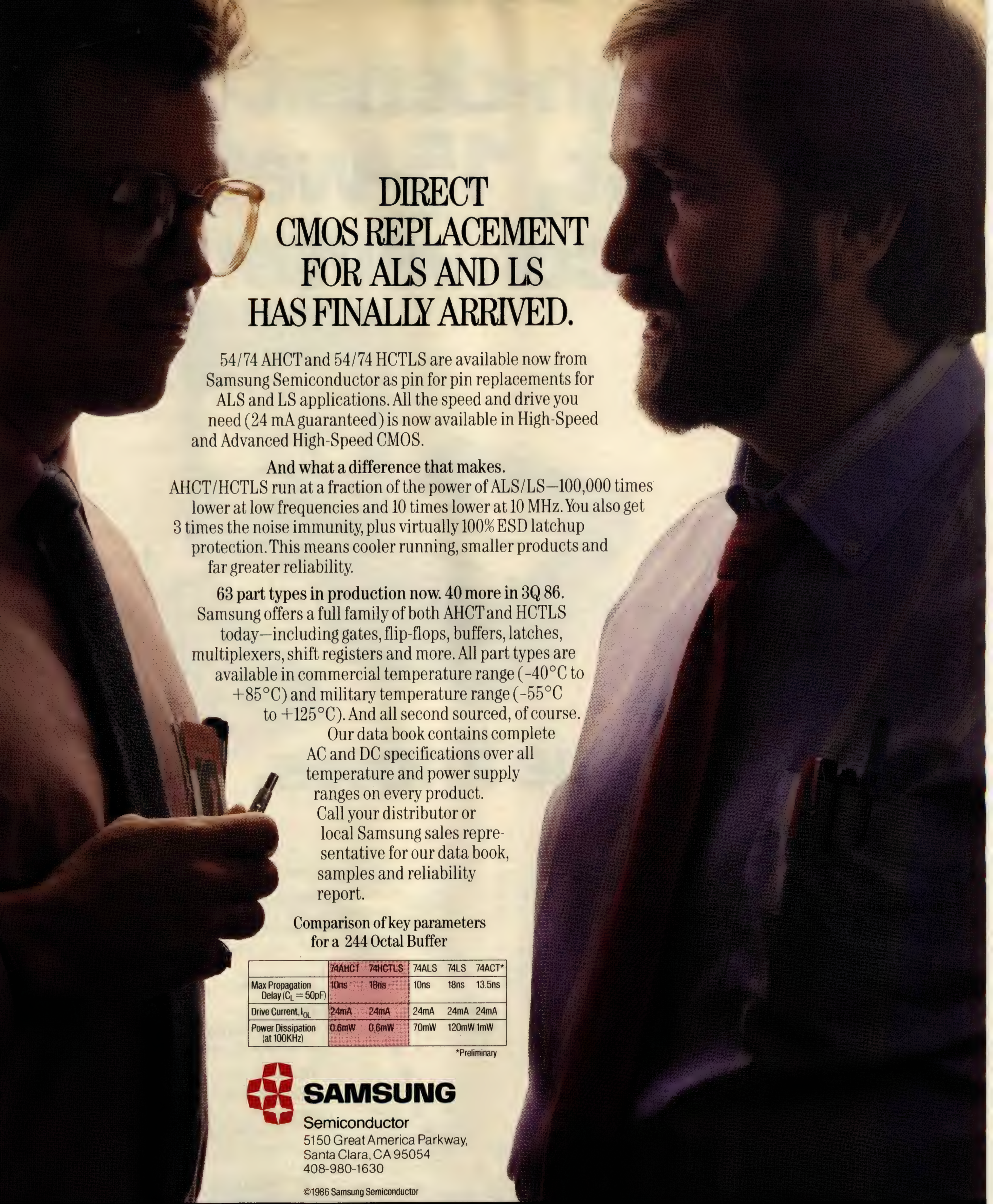

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AHCT/HCTLS run at a fraction of the power of ALS/LS—100,000 times lower at low frequencies and 10 times lower at 10 MHz. You also get 3 times the noise immunity, plus virtually 100% ESD latchup protection. This means cooler running, smaller products and far greater reliability.

63 part types in production now. 40 more in 3Q 86.
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Call your distributor or local Samsung sales representative for our data book, samples and reliability report.

Comparison of key parameters for a 244 Octal Buffer

	74AHCT	74HCTLS	74ALS	74LS	74ACT*
Max Propagation Delay ($C_L = 50pF$)	10ns	18ns	10ns	18ns	13.5ns
Drive Current, I_{OL}	24mA	24mA	24mA	24mA	24mA
Power Dissipation (at 100KHz)	0.6mW	0.6mW	70mW	120mW	1mW

*Preliminary

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CIRCLE NO 178

NEW PRODUCTS: SOFTWARE

STATISTICS PACKAGE

Version 2 of Statpro, which is a menu-driven statistics and graphics database-management package, runs on the IBM PC, PC/XT, PC/AT, and compatible systems under PC-DOS. The program offers a range of capabilities in descriptive statistics, regression, Anova, time series, and multivariate statistics. It also features explicit menu prompts. A data-transfer utility allows you to exchange data between this program and ASCII files, Lotus 1-2-3 worksheets, Symphony, dBase II and dBase III, and other application programs that use the DIF or SYLK file formats. You can use the program with a variety of graphics printers, plotters, and serial printers as well as with the IBM Enhanced Graphics Adapter. Graphics parameters are saved in a disk file, and you can obtain multicolor charts, graphs, histograms, distributive curves, regression plots, and box plots. $795.

Penton Software, 420 Lexington Ave, Suite 2846, New York, NY 10017. Phone (800) 221-3414; in NY, (212) 878-9600.

Circle No 417

RELATIONAL DATABASE

The XDB relational database manager runs on IBM PCs and compatible computers under PC-DOS or MS-DOS version 2.0 or later. The system uses IBM's SQL (Search and Query Language) and conforms to the proposed ANSI standard for relational databases. Using explicit prompts in conjunction with SQL, you can construct tables and enter data without resorting to programming. You can also set up searches and transactions interactively and execute them immediately. A programming-language interface lets you call most of this program's functions from within other programs. You can also transfer data between this program and any other program that uses ASCII files. Most of the functions can run in 256k bytes of memory, but the size of the database is limited only by the disk storage available. $750.

Software Systems Technology, 7100 Baltimore Ave, Suite 206, College Park, MD 20740. Phone (301) 779-5486.

Circle No 418

COMPILERS

Fortran-77, C, and Pascal compilers have been added to the company's 90x, 98x, and 98xe superminicomputers. The compilers generate code running 10 to 300% faster than nonoptimized code; execution speed depends on the application. The compilers work with the company's common language environment, which runs under the dual-port OSx operating system; the dual port incorporates Unix 4.2 BSD and System V. The package permits calls between languages and calls to a common library of run-time routines. Global code optimizations done during code generation include constant computations and other compile-time operations, linearization of array subscripts, recognition and replacement of common subexpressions, removal of invariant computations from loops, elimination of unreachable code, efficient register allocation, and architecture-specific optimizations. The C compiler comes bundled with the company's OSx operating system; the Pascal and Fortran-77 compilers cost $6000.

Pyramid Technology Corp, 1295 Charleston Rd, Mountain View, CA 94043. Phone (415) 965-7200.

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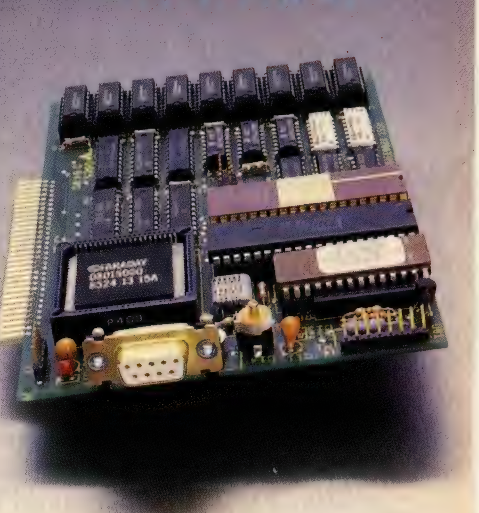
REMOTE DATA ENTRY

Direct Connect, a remote data entry and support communications package, provides direct screen emulation for host and remote screens and keyboards active at the same time. One keystroke allows remote screen capture or entire session recording. The package also allows you to



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transfer ASCII files during sessions. The software emulates and supports video memory-mapped software and DOS video-controller software by selecting forced emulation through a toggle within the program. With the program, you can run diagnostic routines, make program modifications, and provide software testing. It works with Hayes or compatible modems. Less than $300.

Waid Business Consultants, 1106 Clayton Lane, Suite 330W, Austin, TX 78723. Phone (512) 458-8176.

Circle No 420

SYMBOLIC DEBUGGER

Hard-Scope is an interactive source-based symbolic debugger package that works with the company's Mice II in-circuit emulator. By providing a debugger that functions at the same level as the original source program, the program works with Intel chip-oriented Mice II for the 8086, 8088, 80186, and 80188. Features include source-code interface and on-line listings; access to program variables with symbolic data reference; and high-level breakpoints, which you can set by reference to user symbol name, line number, variable equation, or absolute address. It also provides access to assembly-level debugging of in-circuit emulator functions, on-line help messages, and command execution from macro function. The package runs on the IBM PC, PC/XT, or PC/AT using PC/UDI, an implementation of the company's universal development interface. It also works with the iRMX-86 operating system. With UDI package, $6700; Hard-Scope alone, $500.

Microtek Lab Inc, 17221 S Western Ave, Gardena, CA 90247. Phone (213) 538-5369.

Circle No 421

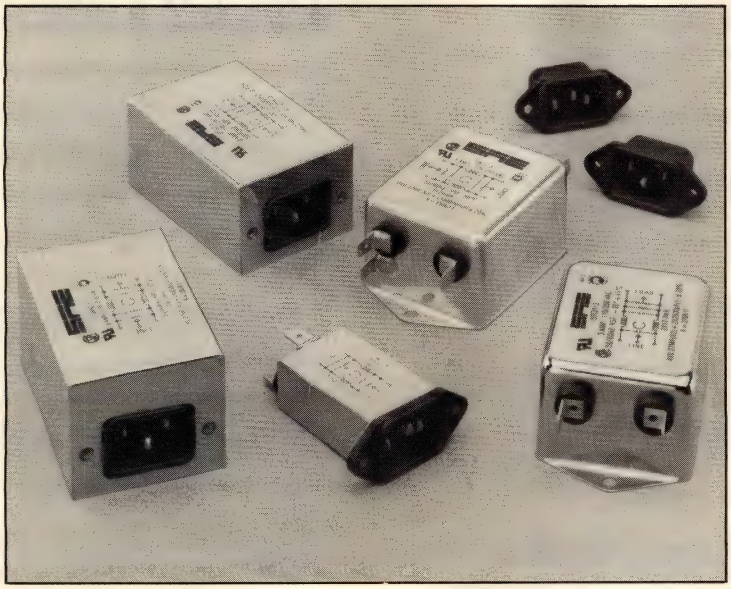
GRAPHICS SYSTEM

The Hieroglyph report-production system integrates text processing, graphics, document aids, document filing, data handling, and production tools. Because the package uses a windowing environment, you can use it for Unix applications. By using a workstation, the software, and a laser printer or typesetting machine, you can perform in-house publishing. The package provides hardware and application independence, multiple window editing, B&W- or color-image production, access to Unix and GKS, and the ability to run concurrent applications. It also furnishes CAD graphics functions, a spelling checker, proportional fonts, and a large font library. It runs on Sun Microsystems' workstations. $2400.

Prescience Inc, 820 Bay Ave, Suite 300, Capitola, CA 95010. Phone (408) 462-6567.

Circle No 422

Listen to the Quiet at SAE.



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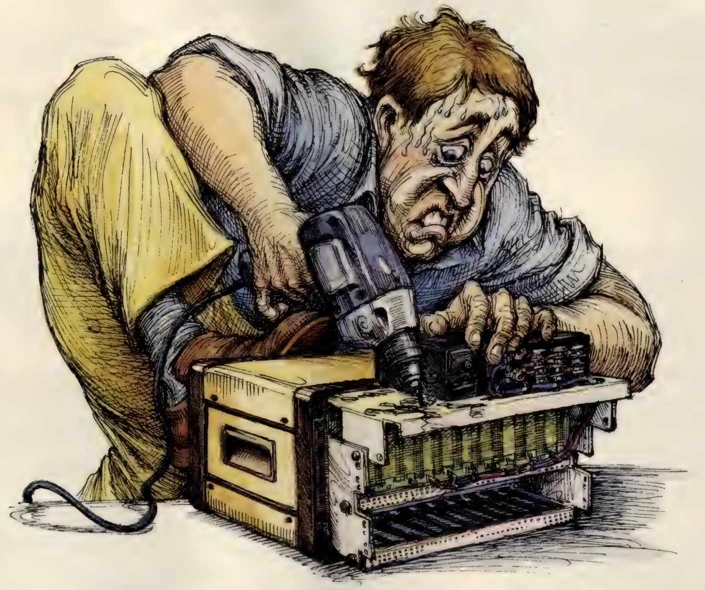

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Chairmen of the Boards

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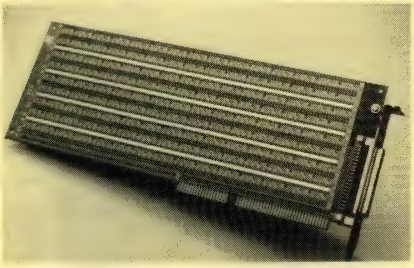

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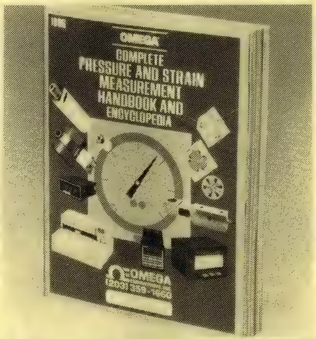

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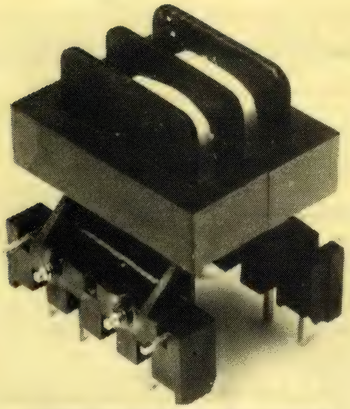

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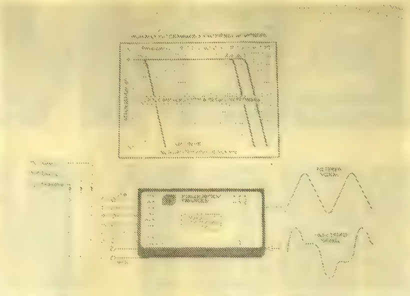

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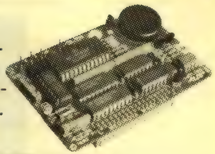

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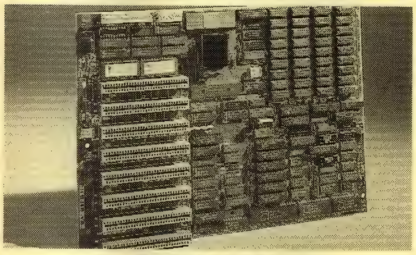

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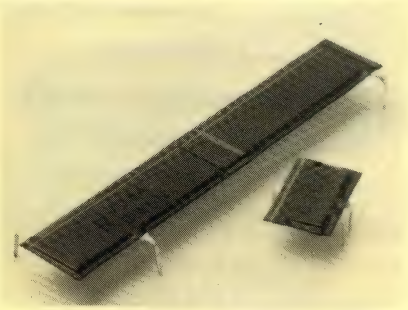

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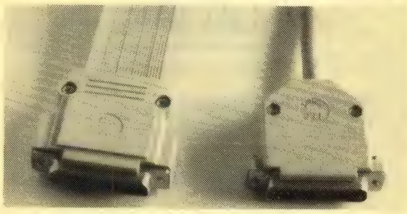

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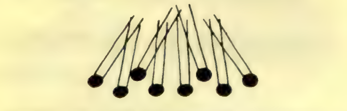

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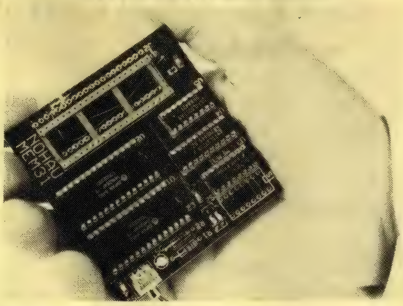

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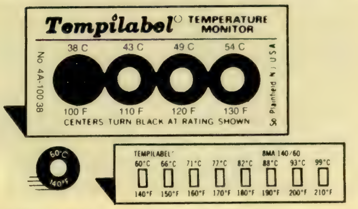
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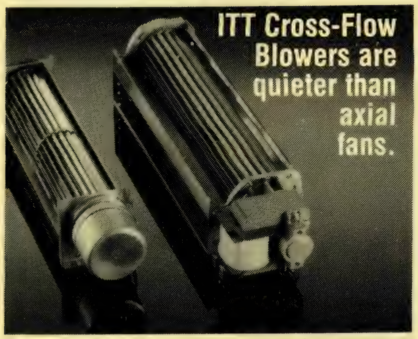

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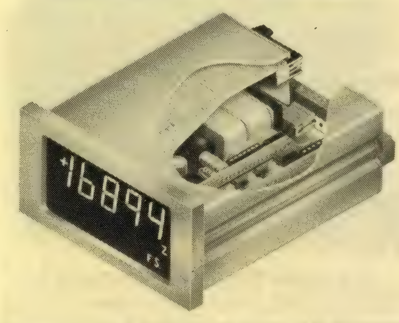

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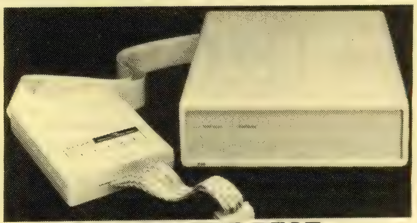

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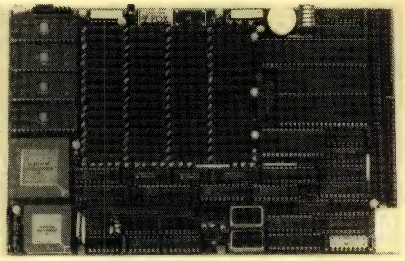

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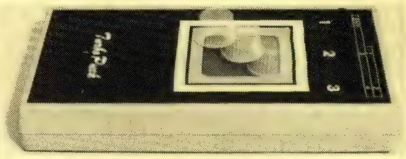

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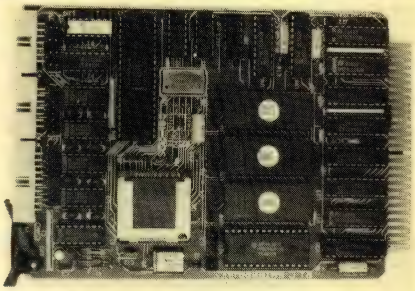

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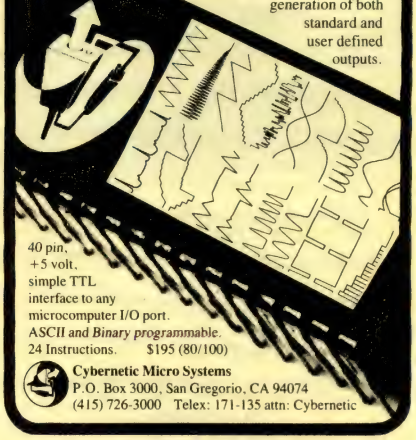

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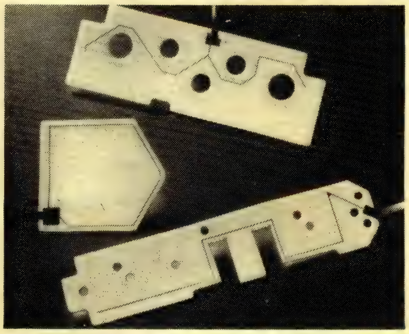

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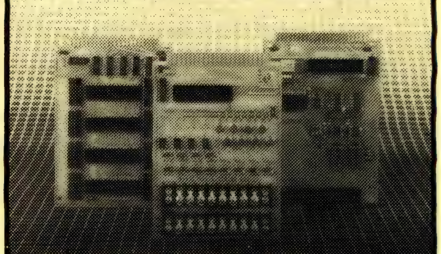

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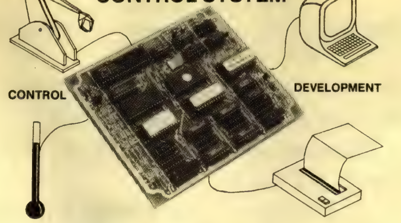

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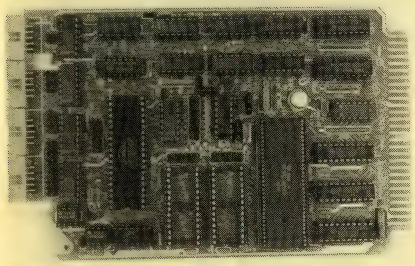

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68020

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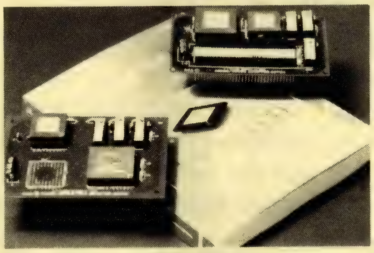


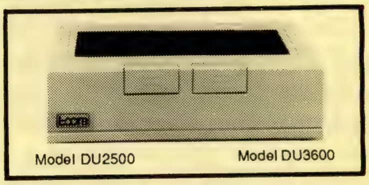
• 500% plus performance. • Plugs into any existing 68000/68010 socket. • On-board 68881 floating point math coprocessor chip. • Runs all 68000/68010 programs. • Great for prototyping the 68020 CPU & 68881 floating point math coprocessor. • 222% Performance improvement over the 68000 at 12.5 mhz; the EDN linked list insertion Benchmark showed at 248% improvement.

CSA **Computer System Associates, Inc.**

7564 Trade St., San Diego, CA 92121/**(619) 566-3911**

CIRCLE NO 258

Data Switch Boxes for RS232 or Centronics



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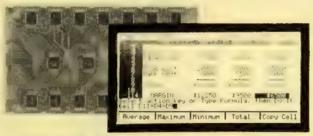

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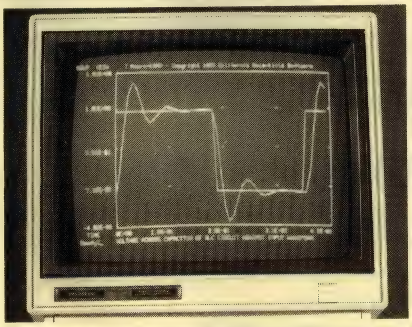

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CIRCLE NO 261

Telecom ICs

Covering the full spectrum of your telecommunications needs

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  CMOS detectors for telephone system tones (dial tone, ringback, busy, special information); CMOS generator for standard call progress tones.
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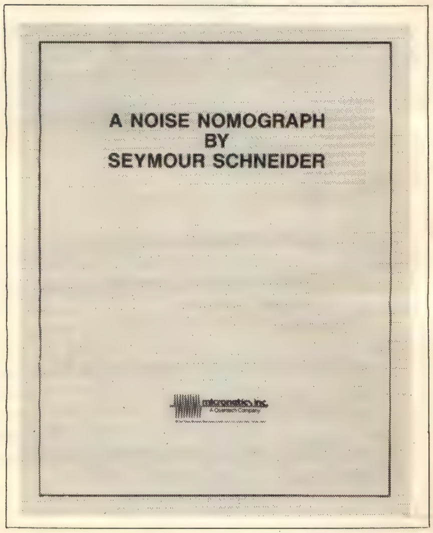
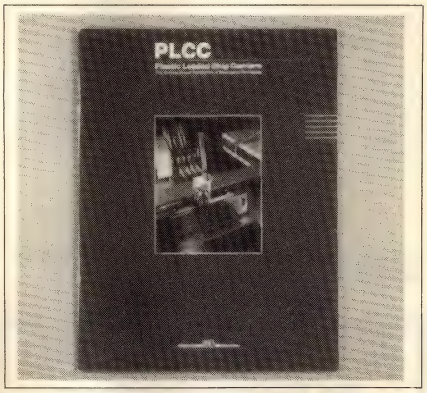


Paper describes how to convert excess noise

A Noise Nomograph will help you convert excess noise ratio (ENR) and $\mu V\sqrt{Hz}$ to power densities and voltages across a specific load impedance. The paper details how you can express the output of a noise source in different ways, depending on system and system frequency. Various examples are included.

Micronetics Inc, 36 Oak St, Norwood, NJ 07648.

Circle No 423

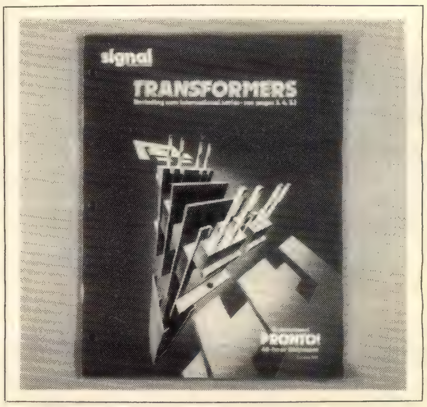


Catalog of surface-mount parts

This 28-pg brochure on surface-mount devices describes surface-mount technology and its development, and the advantages it offers over through-hole mounting. The document provides package drawings and information on thermal characteristics and reliability for the manufacturer's surface-mount parts; plastic leaded chip carriers and pin grid arrays are highlighted. Product descriptions and availability information are given in tabular format. Also included are pinout diagrams and a short section on designing for testability.

Monolithic Memories, 2175 Mission College Blvd, Santa Clara, CA 95050.

Circle No 424



Catalog provides transformer specs

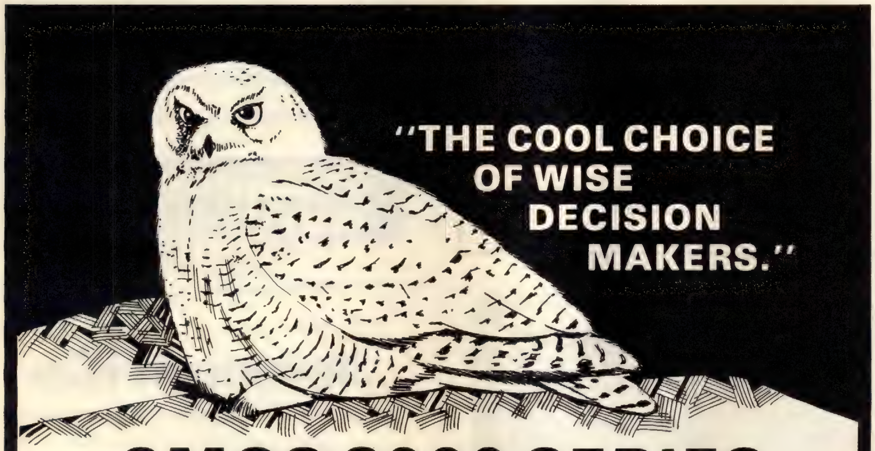
The 24-pg *Catalog G85, Transformers*, contains technical and specification details of the company's power transformers, including its international series. Illustrated with photographs, dimensional drawings, and exploded-construction views, the catalog also describes flat-head and miniature plug-in power transformers in both large-output and pc-board sizes. In addition, it covers filter chokes, dual chokes, step-down auto transformers, and power-isolation transformers. One section explains how to specify power-transfomer and filter ratings.

Signal Transformer Co Inc, 500 Bayview Ave, Inwood, NY 11696.

Circle No 425

Telecommunications needs addressed in booklet

Solid-state solutions for telecommunications needs is the subject of this



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EDN: 3/6/86 Offer expires 45 days from this issue date

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CIRCLE NO 184

4-pg brochure. *Shrink Your Board Size with Harris Telecom ICs* highlights the manufacturer's voice- and data-communication devices. Among the voice-communication components described are PBX ICs, CMOS coder/decoders, PCM filters, and speech-processing continuously variable slope delta (CVSD) modulation devices. Also covered are data-communication ICs, Manchester encoder/decoders and adapters, programmable asynchronous interfaces, serial controller interfaces, UARTs, and programmable bit-rate generators. Request the brochure on letterhead.

Harris Semiconductor, Box 883, MS 53-035, Melbourne, FL 32902.

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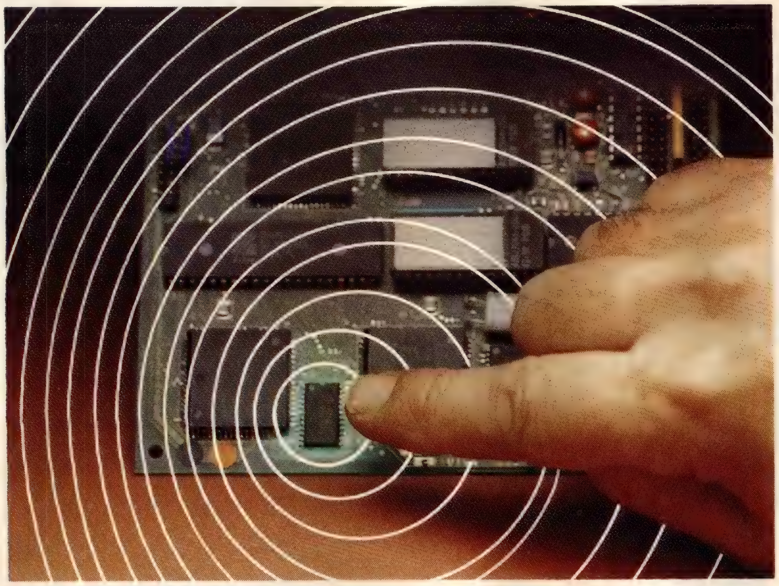

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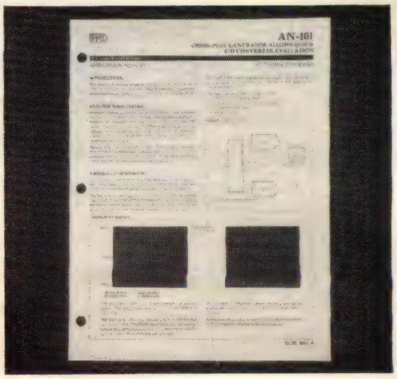
CIRCLE NO 185



AN-101

App note simplifies A/D-converter evaluation

This application note, *AN-101, Cross-Plot Generator Allows Quick A/D Converter Evaluation,* explains that the cross-plot generator provides a simple approach to A/D-converter evaluation. The test method described yields four types of data: missing-code identification, dynamic response, converter code width, and system noise. According to the publisher, the system uses basic test equipment, simple logic and timing, and is compatible with converters of any resolution.

Precision Monolithics Inc, Literature Dept, Box 58020, Santa Clara, CA 95052.

Circle No 427

APPLICATION

Hybrids take on power

App note covers power hybrids

This 4-pg application note describes the materials, packaging, and fabrication processes of the manufacturer's power hybrids. *Hybrids take on*

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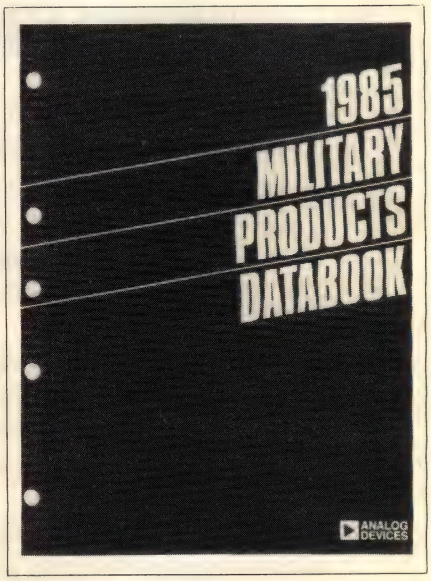
power describes how these chip-and-wire devices have low thermal resistance from semiconductor junction to hybrid case, and how they have low electrical resistance in the circuit path. The note also shows how you can use power hybrids to minimize circuit size and weight.

ILC Data Device Corp, Marketing Dept, 105 Wilbur Pl, Bohemia, NY 11716.

Circle No 428



Military ICs characterized

The 480-pg *Military Products Databook* contains specifications for the manufacturer's monolithic and hybrid ICs that comply with MIL-STD-883C, Rev C. Included are such products as A/D and D/A converters, op amps, and both analog and digital signal-processing components. The book provides general and detailed specs, as well as a MIL-M-38510 cross-reference, a product-selection guide, a glossary, package specs, and a model-number index.

Analog Devices, 70 Shawmut Rd, Canton, MA 02021.

Circle No 429

VME Bus reference covers standards and products

This designer's guide covers VME Bus systems and standards. The

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Kepco **Power Managers** are fully programmable for both voltage and current through their entire rated range, and can deliver full-rated current *and* full-rated voltage at the same time.

For your ATE requirements, unipolar or bipolar, up to 2000 Volts and 1000 Watts, consider Kepco's versatile **Power Managers.**

This Harris AN/USM-484 Hybrid Test System incorporates 10 Kepco power supplies:

- three Kepco ATE 36-3M (0-36 Volts, 0-3 Amps)
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- one ATE 25-4M (0-25 Volts, 0-4 Amps)
- one ATE 6-10M (0-6 Volts, 0-10 Amps)
- one ATE 15-6M (0-15 Volts, 0-6 Amps)
- one ATE 55-2M (0-55 Volts, 0-2 Amps)

Programming these Power Managers to the appropriate test levels are one single channel Kepco SN 488-121, and four dual channel SN 488-122 digital interfaces that read their instructions from Harris' IEEE 488 bus and provide optically isolated commands to the Kepco Power Managers.

Write Dept. HOF-12, KEPCO, INC.
131-38 Sanford Avenue
Flushing, NY 11352 USA
(718) 461-7000
TWX # 710-582-2631
FAX: (718) 767-1102
CIRCLE NO 188

6-pg document covers the VME Bus development environment and selection criteria for both hardware and software products. It includes a summary of such typical VME Bus products as processors, memories, I/O devices, mass-storage units, and other parts. It also contains a 1-pg VME Bus primer.

Plessey Microsystems Inc, 1 Blue Hill Plaza, Pearl River, NY 10965.

Circle No 430

Glossary focuses on machine vision

This 96-pg glossary defines machine-vision terms for those individuals using or planning on using such technology. The glossary, which contains more than 700 terms, is published by the industry's machine-vision trade group for $9 ($7 for AVA member companies); discounts are available if you order 10 or more copies.

Automated Vision Association, Box 1366, Dearborn, MI 48121.

INQUIRE DIRECT

Rad-hard products listed

Describing to what level major high-tech systems can be protected against radiation, *Radiation Effects on CMOS* covers ionization radiation, types of radiation, and radiation hardness. The brochure includes a list of the manufacturer's rad-hardened custom, semicustom, and specialized circuits. Among the CMOS parts are μPs, memory devices, multiplexers, bus-interface circuits, and op amps. Also included are analog switches, gate arrays, and a standard-cell family. Request via letterhead.

Harris Corp, Box 883, MS 53-035, Melbourne, FL 32902.

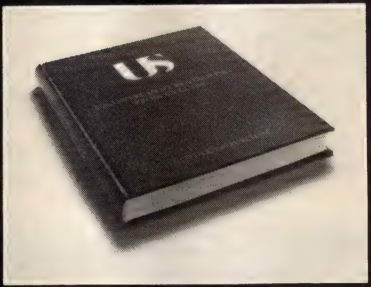
INQUIRE DIRECT

Catalog highlights DEC-compatible products

Featuring Q Bus-, Unibus-, MicroVAX- and VAX-compatible products, this catalog provides prices, photographs, and operational/functional descriptions of the manufacturer's products. The catalog describes advances in communications processing, multiplexing and data transmission, ultrahigh-speed mass-storage and other memory-device controllers and subsystems. The book also covers the manufacturer's traditional product line of peripheral-device controllers, communications interfaces, general-purpose and foundation modules, interprocessor links, and bus switches.

MDB Systems Inc, 1995 N Batavia St, Orange, CA 92665.

Circle No 433



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Viking introduces the simple, complete answer to the problem of low cost reliability in card edge connectors: a combination cantilever beam contact and thermoplastic insulator. We've designed an entire line of card edge connectors around this concept and automated its production. Then named it *Cost-Driven*. For obvious reasons.

This simple design brings prices down, yet retains the uncompromising quality for which Viking is known. This kind of reliability has resulted in accreditation, ship-to-stock, and Just-In-Time programs with major companies.

These connectors are preloaded to provide a minimum of 100 grams of normal force per contact, assuring reliable connections in worst case conditions. The bifurcated contacts provide added assurance through redundancy. And the connectors are U.L. listed, not merely "material approved".

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For the IBM PC AT™ motherboard and compatible products, here's the simple, complete way to eliminate the need for two end-to-end connectors: Viking's 18 plus 31 position dual card slot connector. It reduces installation costs. Reduces material costs. And it can be packaged for automatic assembly.

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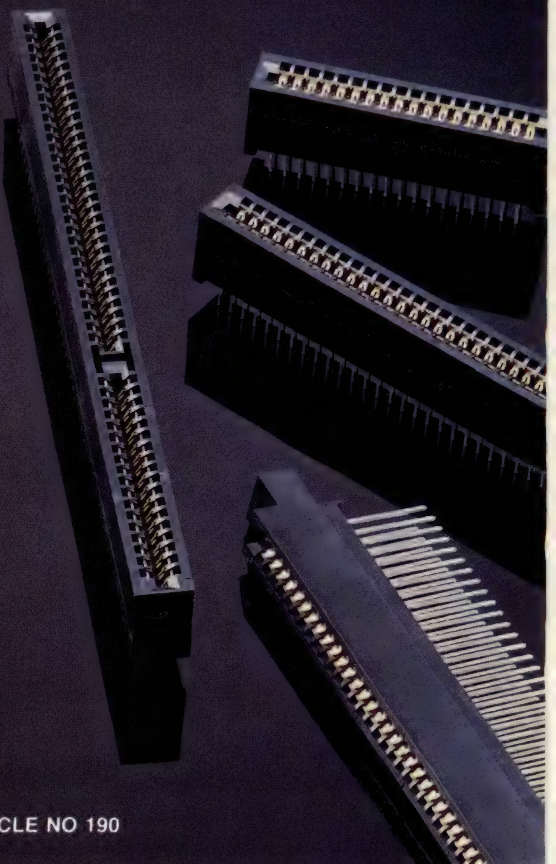

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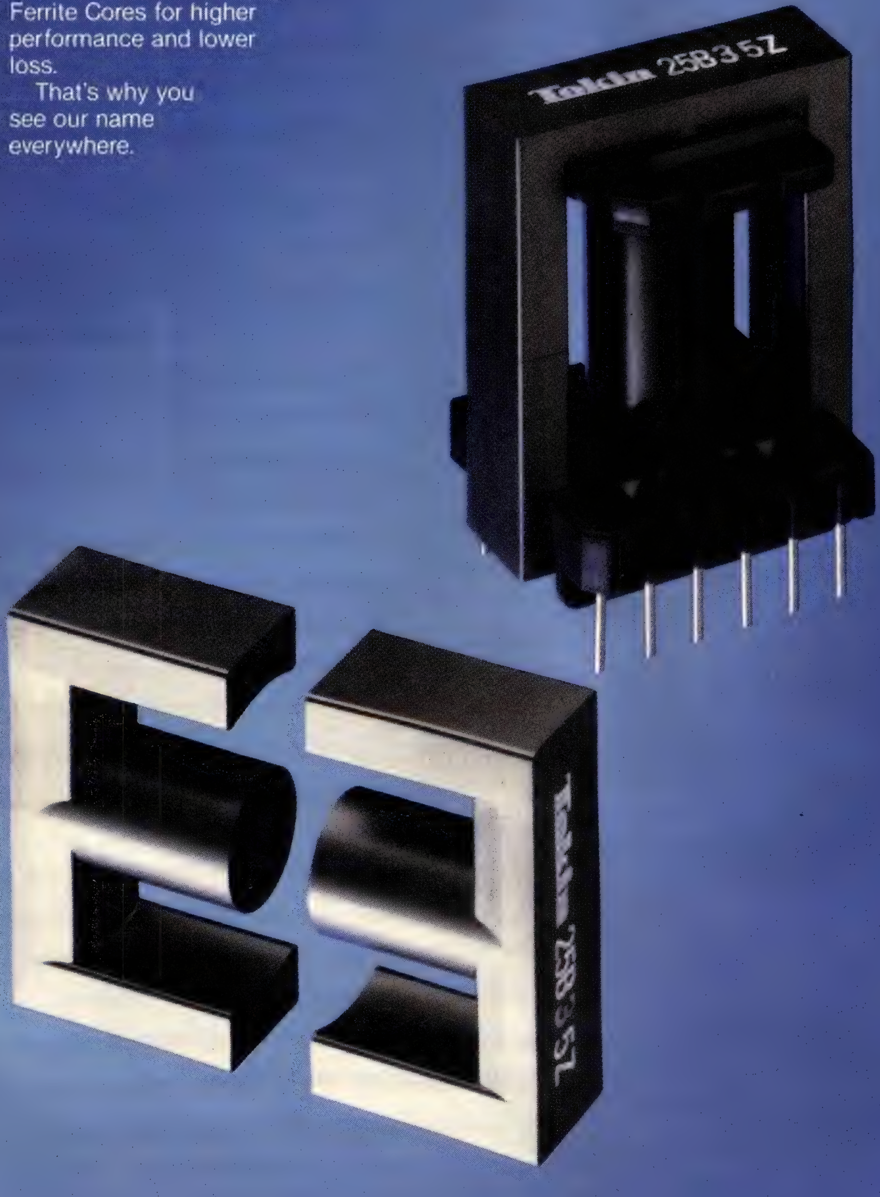
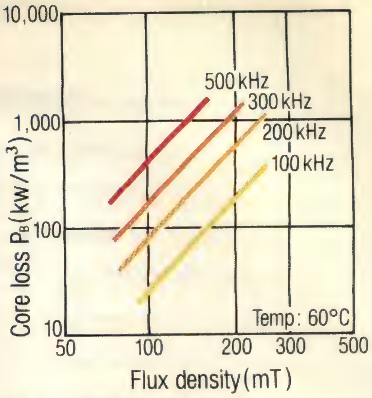
Tokin. A wide variety of Ferrite Cores for higher performance and lower loss.

That's why you see our name everywhere.



Core Loss vs. Flux Density(2500B3)



Material Characteristics

Material			2500B	2500B2	2500B3
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Effective saturation magnetic flux density*	Bms	20°C mT	490	500	500
		100°C mT	380	380	380
Effective retentivity	Brms	20°C mT	100	130	80
		100°C mT	80	65	60
Effective coercivity	Hcms	20°C A/m	15.9	15.1	15.1
		100°C A/m	11.1	8.7	7.9

* 15 Oe (Approx. 1.200 A/m)

Tokin

Tokin Corporation

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CIRCLE NO 191

As issue of EEs' career guidance heats up, companies take steps to orient young recruits

Deborah Asbrand, *Staff Editor*

Orientation programs for entry-level engineers, long a tradition of large companies, are taking on a new look. Now, instead of offering new employees a morning's lesson in the company's inner workings and then handing them a company manual, large electronics companies are expanding their orientation sessions to provide newcomers with a thorough knowledge of the company and its industry, and of engineers' roles within the company. In some cases, these orientation programs include graduate-level courses.

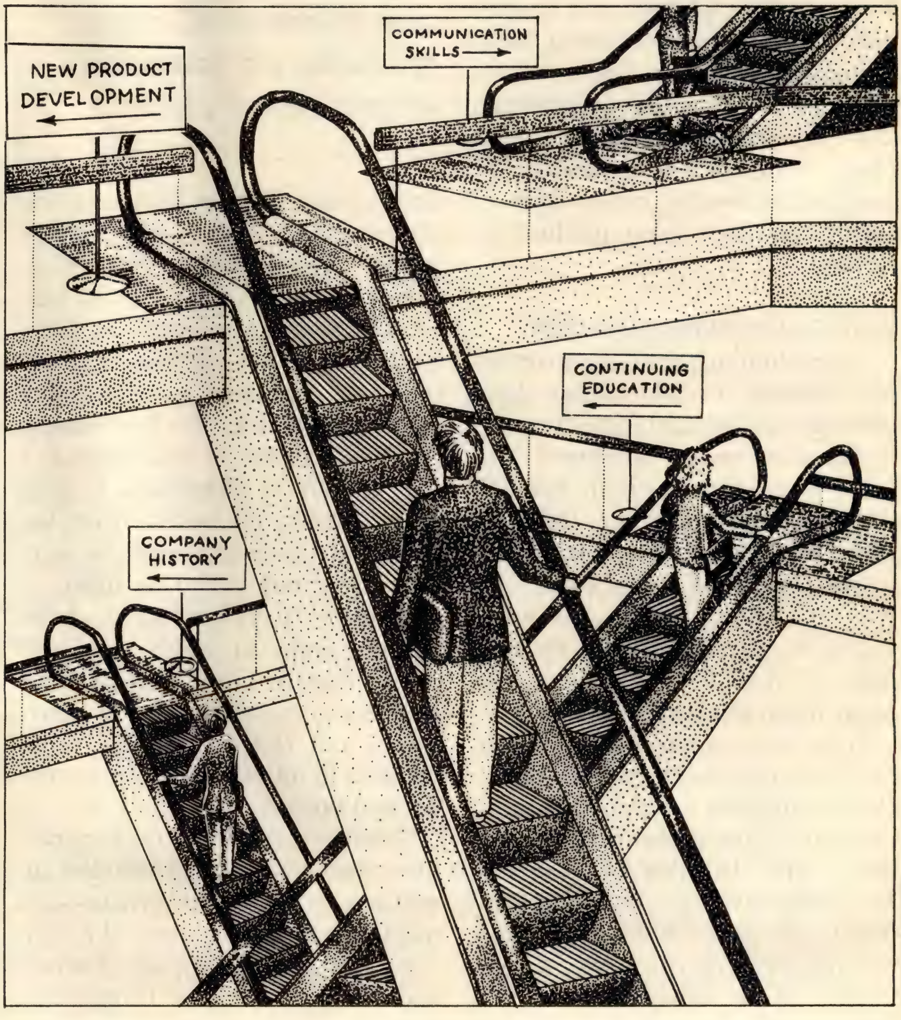
A variety of influences have prodded industry to improve its training of engineers fresh out of college. These influences include industry's recognition of its own training responsibilities, electronics companies' desire to remain competitive, and mounting criticism that undergraduate engineering programs are not providing sound professional preparation.

At an IEEE conference on engineering careers held last fall, debate became heated about whether the responsibility for arming students with realistic career information lies with teachers, counselors, or industry. Those who support the inclusion of practical, nontechnical career information in undergraduate programs say that, without such information, colleges are turning out graduates unprepared for professional careers.

"Orientation for young engineers is extremely important so they know where they are and what they're supposed to do," IEEE president Bruno Weinschel told the conference audience. "We have the brightest young people entering the profession . . . but we're not orienting them well enough. More than 75% of bachelor of science graduates are going into industry, but fewer than 50% of engineering faculty has industrial or work experience."

For their part, electrical-engineering deans and department heads say their crowded teaching schedules do not permit the addition of any courses on career issues. Two-thirds of the deans and department heads who responded to a recent IEEE survey say a course on professional awareness should not be incorporated into undergraduate curricula. Seventy-eight percent prefer to see career information passed along to students through seminars or student-sponsored activities.

Unfortunately, removing guidance responsibilities from the classroom is not a solution to the problem, as many professors will admit. College counselors' efforts to paint a realistic picture of what students' jobs in industry will be like—a difficult task at best—are sorely inadequate, says one engineering professor. "Career counseling is a national disgrace," engineering professor



David Kenefick

Fred Landis of the University of Wisconsin at Milwaukee told attendees of the IEEE conference. "How do you tell a 19- or 20-year-old what a culture shock it is going to be for them in the real world?" Indeed, only 24% of respondents to a National Science Foundation study on engineering utilization report they were satisfied with the career guidance they received as undergraduates.

Rather than point the finger at academia's inadequacies, however, many large companies are acknowledging their own responsibilities and taking it upon themselves to improve their orientation programs. Their reasons are not entirely altruistic, says Scottsdale, AZ-based consultant Janet Fiero. "Engineers tend to feel lost in a big company, and they wonder how they're contributing to it," she says. A sense of detachment, not uncommon among employees at a large company, can slow a worker's productivity. By working to eliminate that large-company lethargy, says Fiero, companies are banking on measurable results in the form of better and more timely product designs.

Keeping the competitive edge

In addition to increasing a company's chances to gain market share over its competitors, effective orientation of young engineers also helps a company position itself to maintain that edge for the long term. By introducing new engineers to the companies' culture and purpose at the outset, employers are taking measures to prevent the feelings of disillusionment that can occur down the road.

Today large companies are hoping to bring newcomers into the fold by clearly outlining the career and educational opportunities the company has to offer. In doing so, companies are giving new engineers opportunities to ask questions about a company's products, divisions, and subsidiaries. More important, they're giving new employees the opportunity to meet senior engineers as well as other company freshmen.

Though a college graduate's first job can be a jarring experience, and a large company's size and complexity can make the experience an even greater jolt, engineering positions at large companies remain sought-after jobs by many students. IBM, Hewlett-Packard, General Electric, and Texas Instruments were the top four employers of choice for electrical-engineering students, according to a 1983 study by *Graduating Engineer* magazine.

Hewlett-Packard is typical of large companies who have seen the virtues of thorough orientation programs. The company has maintained such programs for its employees since its inception in 1939. Each year, its more than 1000 entry-level engineers go through a 3-step orientation. The first session gives an outline of the company's history and its objectives. It lasts approximately six hours. After the initial corporate introduction, company freshmen spend as much as two or three days learning about the specific areas in which they will work. They're introduced to other projects going on in their department, and they learn how those projects fit into the company's product and business strategies.

Those who support the inclusion of practical career information in undergraduate programs say that, without such information, college graduates are unprepared for professional careers.

The third segment of the program introduces new engineers to the operations of their own division—the manufacturing processes, the educational opportunities, and the tools and services available. In addition, new engineers might take classes or seminars as part of their orientation. The company considers this divisional introduction to be the most important part of the program. Within Hewlett-Packard's decentralized corporate structure, its divisions are "the lifeblood of our business," says Albert Siu, manager of personnel-development programs.

Hewlett-Packard is always modifying its programs, particularly at the divisional level, says Siu. General Electric, however, has taken more aggressive steps. It recently revamped an existing specialized orientation program for engineers and created a second program. The company-wide programs enroll approximately one-third of the recent engineering graduates the company hires each year. General Electric's individual businesses provide their own engineering development programs for entry-level engineers not in the specialized programs.

GE's restyled program, known as the Edison Engineering Program, enrolls 150 new electrical- and mechanical-engineering graduates each year. Participants rotate through four jobs during the 2-year program. In addition, they spend four hours each week taking graduate-level courses and are assigned 16 hours of homework. At the conclusion of the first year, participants are brought together for a week-long class in communications and leadership. They continue their studies through the second year and, when the program concludes, have earned two-thirds of the credits required for a master's degree.

The 1-week course is a new addition to the program, says Robert Anderson, GE's manager of technical educational operations. It provides participants an opportunity to learn management skills as well as meet other newcomers. The program offers a "clear channel for the development of engineering leadership within the company," says Anderson.

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GE's new orientation program is also a 2-year program, and it also enrolls 150 new engineers each year. The thrust of the Manufacturing Management Program, however, is in such technologies as robotics and in such production issues as just-in-time manufacturing.

Getting to know IBM

IBM, like Hewlett-Packard, does most of its training of new employees on a decentralized basis. In 1984, however, IBM added two company-wide programs to its training procedure, including a special 1-week course for engineers and programmers. For all new professional employees, the company offers a week-long course on IBM—its history, heritage, and personnel practices.

For engineers and programmers who go to work for the largest computer manufacturer, a second week-long course introduces them to the company's product development process. Attendees examine how the company designs, develops, manufactures, and markets new products. Representatives from the company's divisions are trained to teach the course, and they then tailor the course material to their own facilities' needs. A third course currently being developed will provide an overview of the information-processing market segments in which IBM operates.

What companies are starting to do, says Fiero, is give definitive answers to every new recruit's questions. Young engineers are learning who the technical experts are, where they fit into the company, and whether they will get to do work that is of value to the organization. **EDN**

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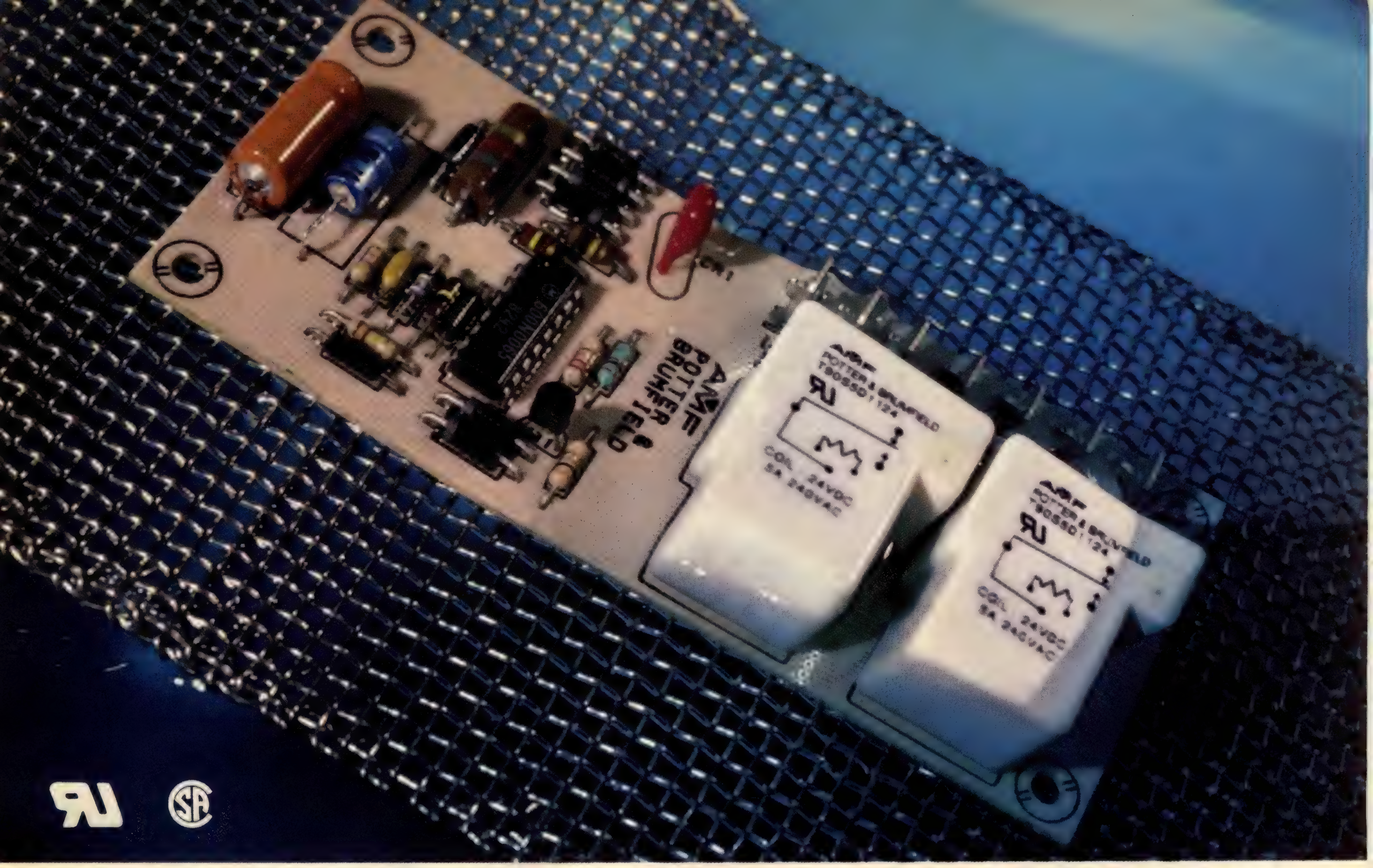

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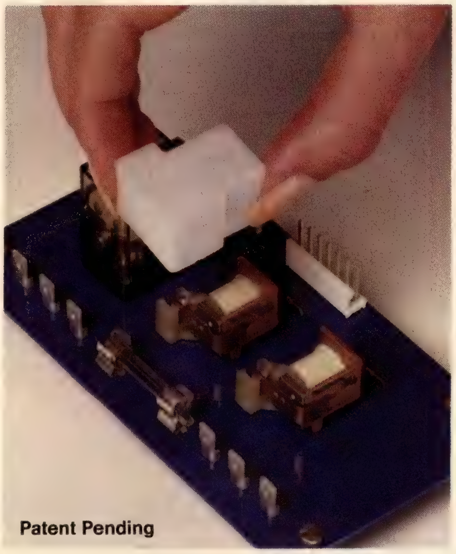

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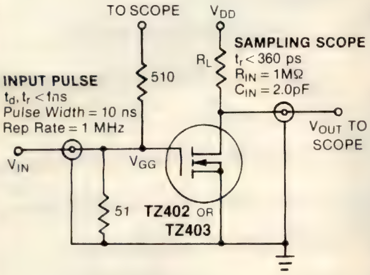

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National Sales Manager
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Production Assistant
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Cahners Magazine Division
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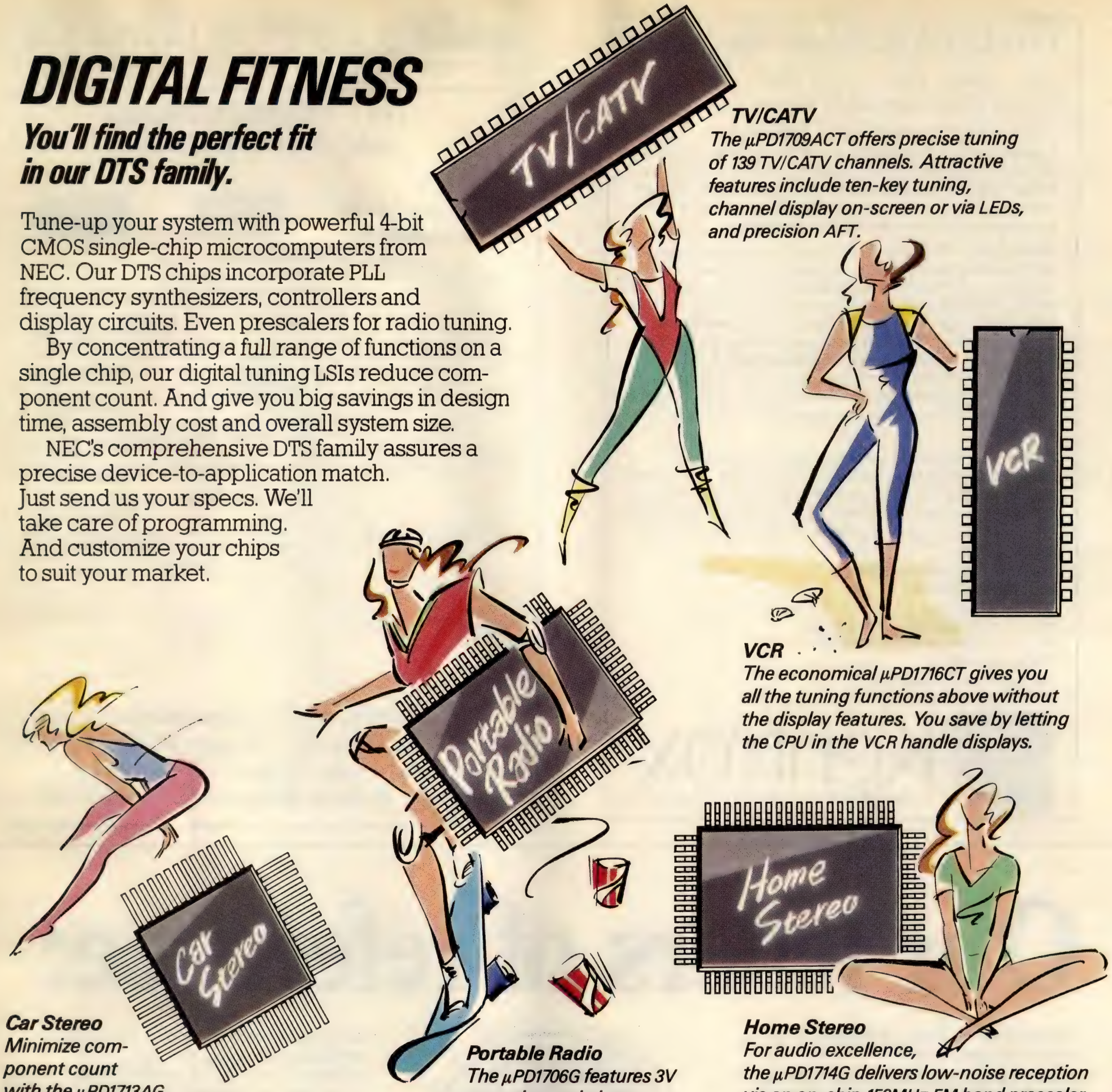

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May 1	Apr. 4	Electro '86 Show Issue; Sensors/Transducers; ICs; Test & Measurement; Display Technology	Closing: 5/8 Mailing: 5/20
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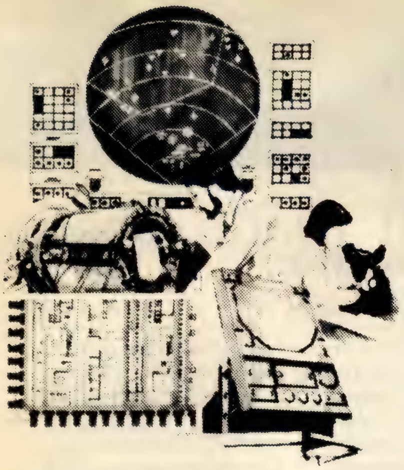

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LOOKING AHEAD

EDITED BY GEORGE STUBBS

Molded wiring boards make gains on pc-board market

Printed-circuit boards based on injection-molded thermoplastic substrates will make great gains in popularity throughout the remainder of the decade. According to the market-research company Phillip Townsend Associates Inc of Marblehead, MA, worldwide demand for these molded wiring boards will amount to 30 million square feet by 1990. The potential demand could reach 70 million square feet in the US alone. This figure means that molded wiring boards could constitute 20.2% of US pc-board volume (estimated at 347 million square feet for 1990) if all applications that could use the new technology actually did so.

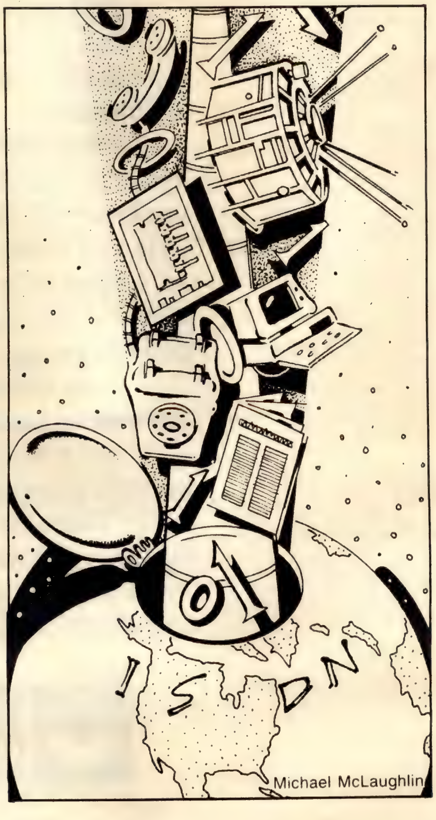
PC boards based on injection-molded thermoplastic substrates best suit high-frequency and high-temperature applications that historically have required specialized laminate structures (see "Engineering-grade thermoplastics enhance pc-board design options," EDN, August 8, 1985, pg 67). Molded circuit boards require little, if any, additional mechanical work—drilling, beveling, stamping, or blanking—and as a consequence they provide a good match with surface-mount devices.

Phillip Townsend Associates reports that the leading resins being considered for such thermoplastic substrates are moderately expensive engineering materials such as General Electric's Ultem polyetherimide, Imperial Chemical Industries' Victrex polyethersulfone, and Union Carbide's Radel polyarylsulfone resins. Researchers believe, however, that new circuit-manufacturing techniques—possibly including alloys of thermoplastic polyester and other materials—may lead the way to lower-cost engineering resins.

According to the research company, the initial penetration of molded wiring boards will be in the automotive, computer, consumer, and communications industries. Company analysts believe that double-sided molded wiring boards may be cost effective in production volumes as low as 4000 square feet, and that utilization of the 3-dimensional capabilities of the injection-molding process, to realize such features as ribs, bosses, stand-offs, and ramps, can reduce the production volume still further by cutting assembly costs.

Companies should plan now for implementation of ISDN

It sounds improbable, but the world may one day be linked by a single communications supernetwork that employs standard protocols for the digital transmission of voice, video, text, and data. Such is the promise of the Integrated Services Digital Network (ISDN), which for a decade now has been the object of research by telephone operating companies and communications-equipment vendors. And if related industries don't plan now, says SRI International (Menlo Park, CA) in the winter issue of *Electronics Strategies*, they could be at a disadvantage when the dream becomes a reality.



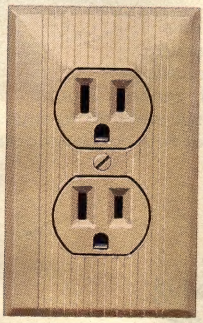
Michael McLaughlin

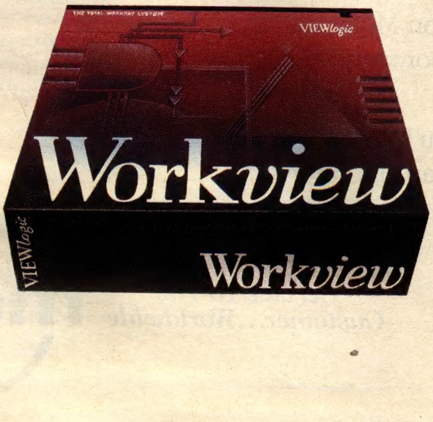
The time to start thinking about how the ISDN will change telecommunications networks is now, says SRI. Though the fully integrated worldwide network won't be achieved at least until the year 2000, the public networks that will form the fundamental cells of the larger network should start to appear in two to four years. Telephone companies can prepare by digitizing their networks and installing the fiber-optic links that will be required to handle the expected large volumes of communication. Many companies are already taking such measures, believing that they make good sense, ISDN or no ISDN.

"If telephone operating companies wait too long to offer public ISDN networks, the largest users—and the best potential customers—may go digital on their own to take advantage of digital's cost savings and capabilities. In short, they may bypass ISDN altogether," says SRI senior consultant Anne D Belfort, speaking in *Electronics Strategies*. The initial steps the telephone companies can take will be necessary to keep their customers in the fold, and both parties will consequently be ready to take advantage of the ISDN when it does finally appear.

One problem that will continue to delay the realization of the ISDN is a problem that has always plagued various segments of the communications industry—that of standards. The scope of the project, calling for worldwide network compatibility, compounds the problem. Currently, the International Telegraph and Telephone Consultative Committee (CCITT) is working on standards for all aspects of the ISDN.

EVERYTHING A DESIGN ENGINEER NEEDS, TO DO EVERYTHING A DESIGN ENGINEER DOES.





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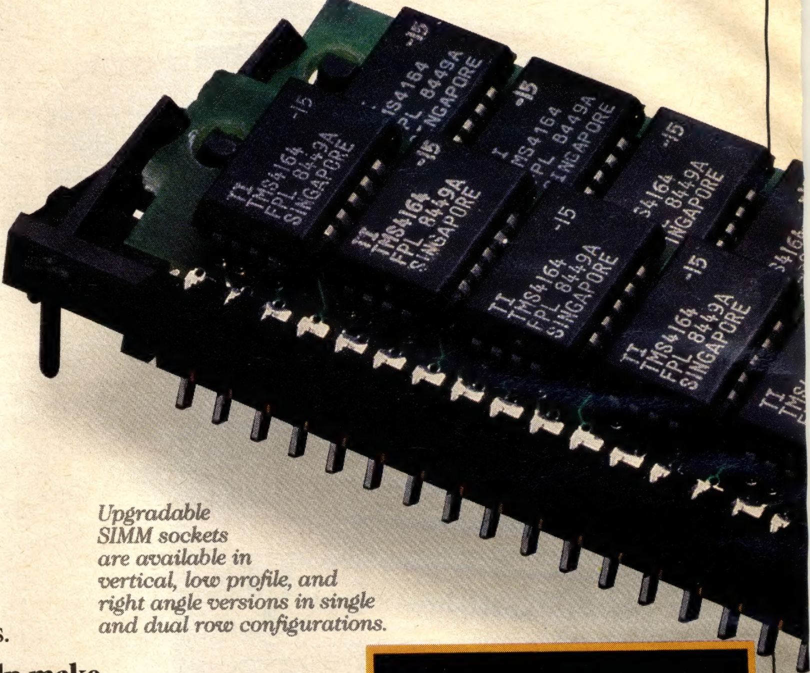
CIRCLE NO 206

Making the Connection Between…

PACKAGING & PRODUCTIVITY



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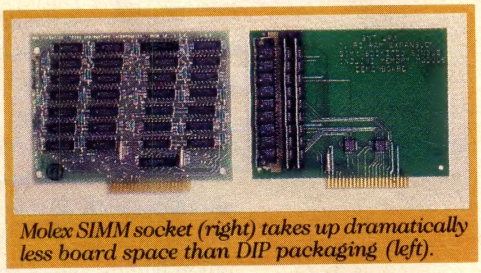
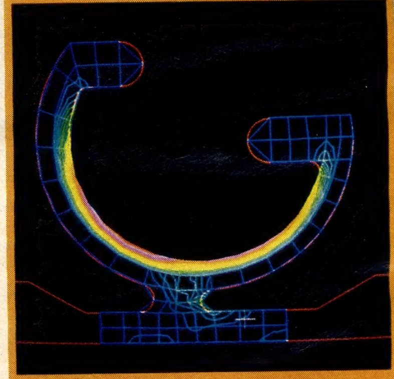


Molex SIMM socket (right) takes up dramatically less board space than DIP packaging (left).



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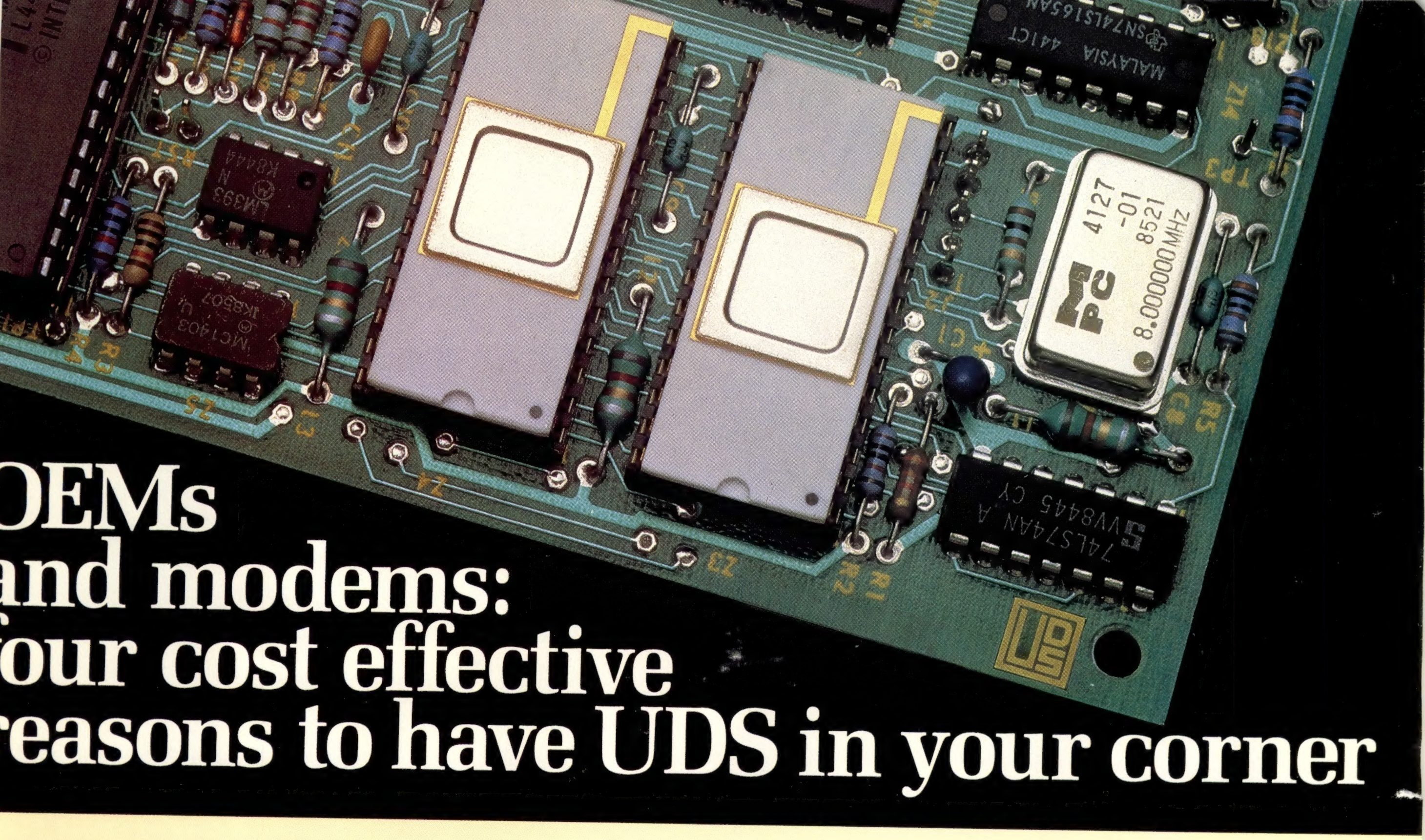
CIRCLE NO 200



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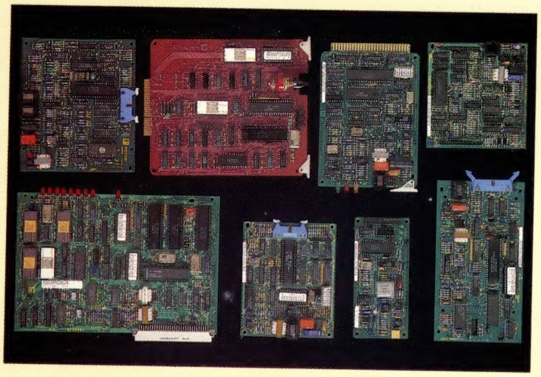

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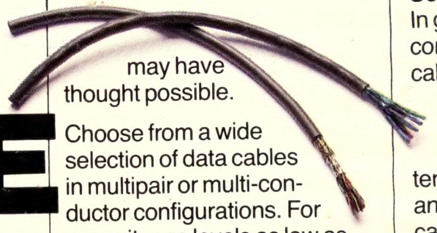

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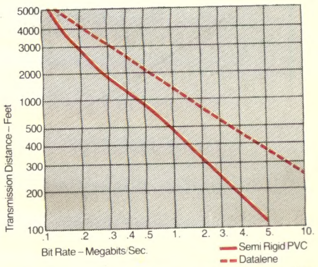
Bit rate vs. distance for individually shielded single pair cables.



Charts assume 5% peak to peak time jitter as determined by eye pattern measurements of pseudorandom NRZ code.

Settling a bit of confusion.

In general, low capacitance contributes to a better computer cable. However, at higher bit rates, the distance trade-off becomes more dependent on other cable parameters such as shielding, impedance and attenuation. "Low capacitance" can no longer define the performance requirements you need. Belden offers an examination of performance by addressing all parameters of data cables as they are affected across the bit rate spectrum in RS-232 and RS-422 applications. When it comes to optimizing performance, there is no equal to Belden.

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